THIS ISSUE IS IN TWO PARTS—PART I

SEPTEMBER 1960

ENGINEERING DATA FILE

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# Heating Piping & Air Conditioning

**. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings**

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**Heat Pump Reclaim System Proves New Design Approach**
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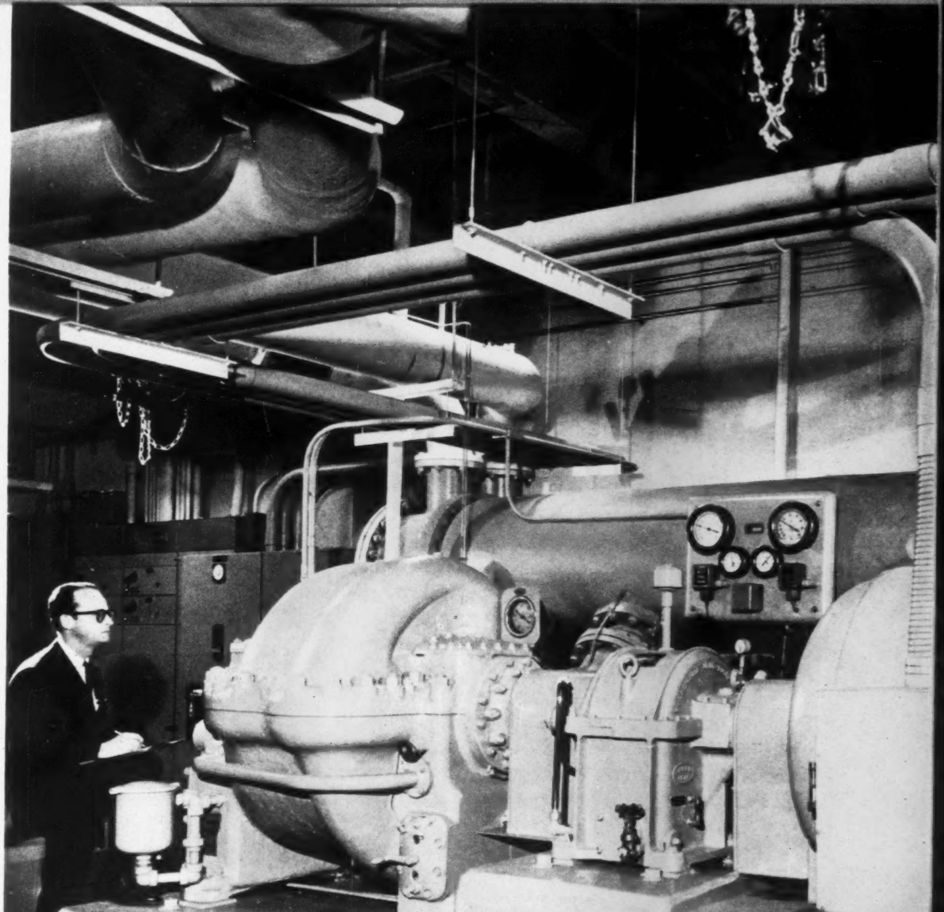

Hot reheat pipe of new 325,000 KW unit No. 5 at Pacific Gas and Electric Company's Pittsburg Power Plant in California, showing line-up of 3 Grinnell Constant Support Hangers.

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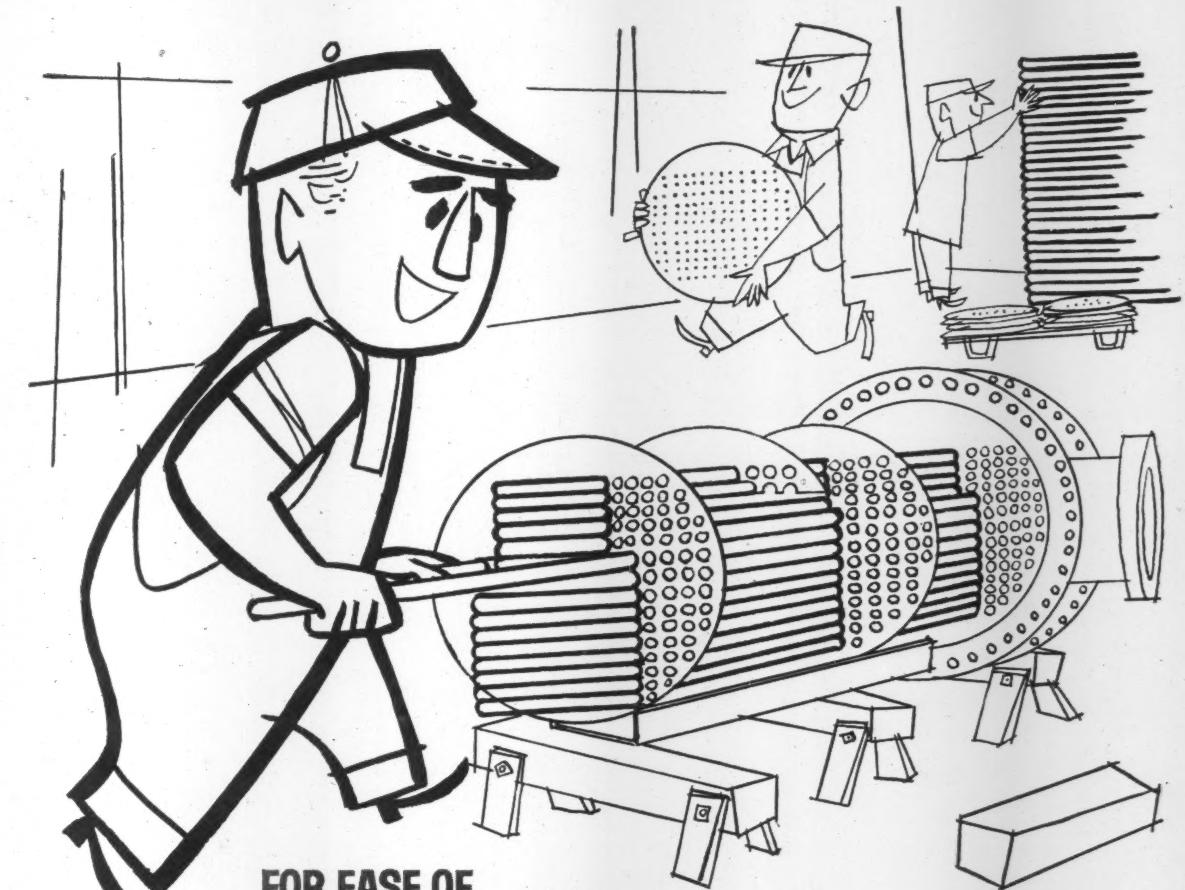

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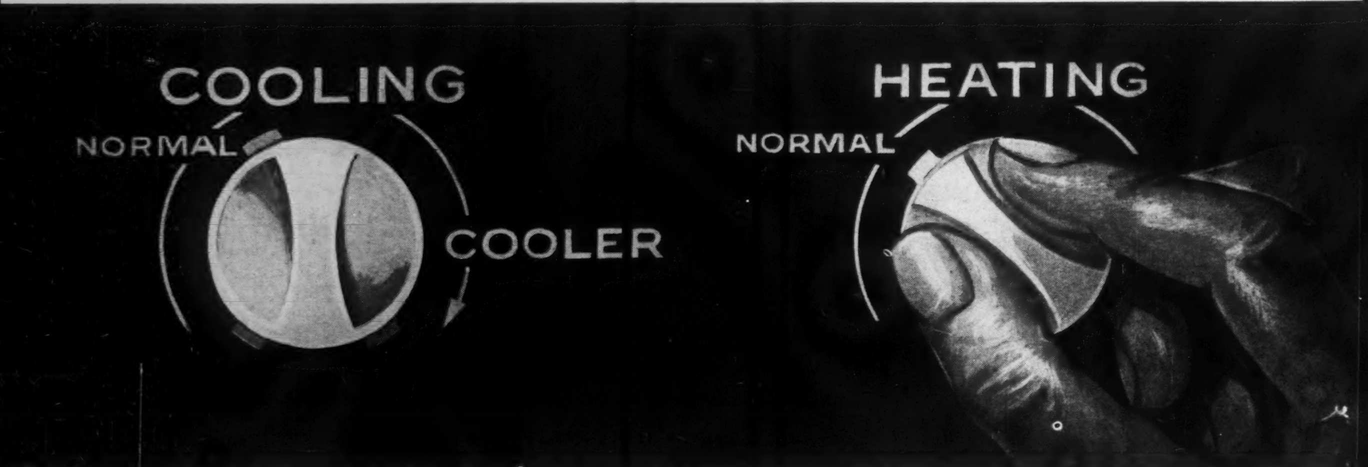

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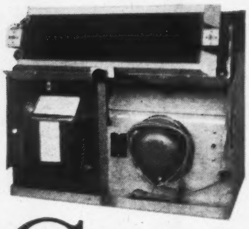

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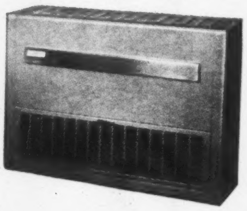

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FOR CONSULTING ENGINEERS, MECHANICAL (HEATING, PIPING, AND AIR CONDITIONING) CONTRACTORS, ENGINEERS WITH PLANTS AND BIG BUILDINGS

VOL. 32, NO. 9 SEPTEMBER 1960

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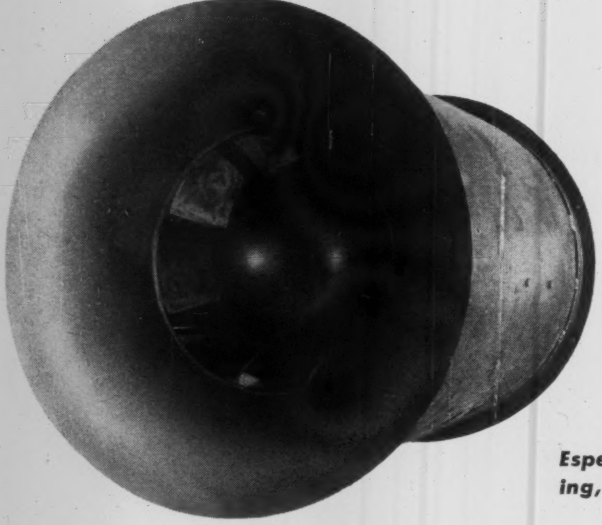

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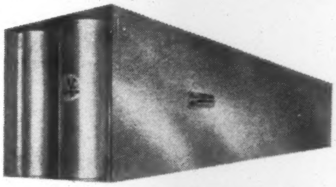

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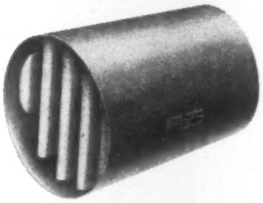

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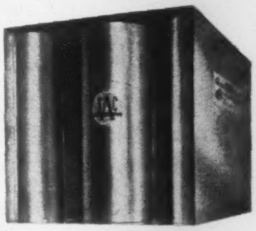

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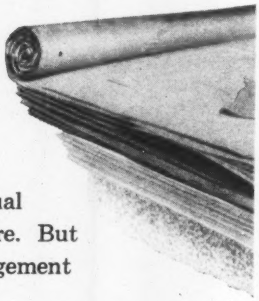
# How *Imaginative Engineering* Uses Pneumatic Temperature Control To Guarantee Year 'Round Patient Comfort



Scott & Kinney, Kansas City consulting engineers, took a new look at an old problem and designed a *different* heating and air conditioning system for the University of Kansas Psychiatry Building. Their unusual method features two separate fan systems and a unique automatic damper application that eliminates the noise and distribution problems usually encountered with ordinary single-fan systems.

Providing uniform year 'round temperature together with foolproof individual room control has always been a problem in designing buildings of this nature. But Scott & Kinney provided the solution in their selection and imaginative arrangement of a Powers Pneumatic Control System.

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MECHANICAL CONTRACTOR:
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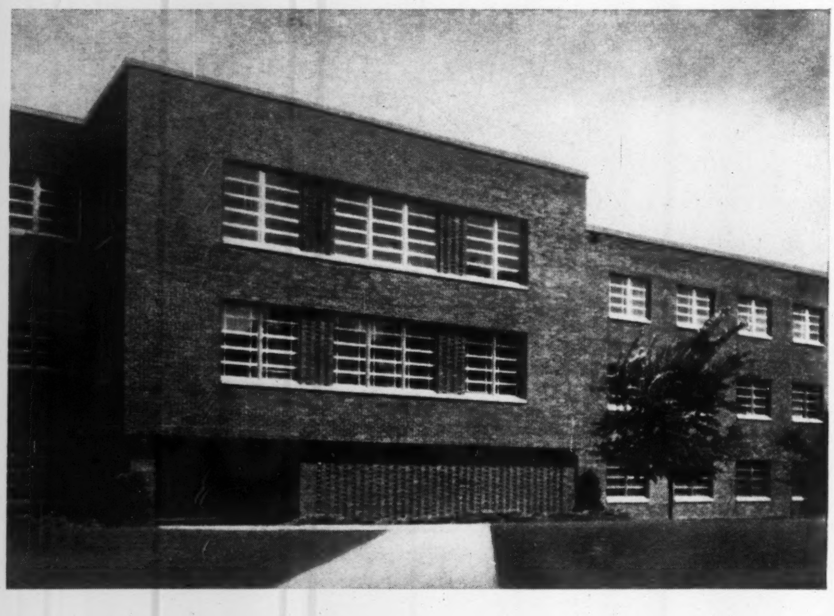
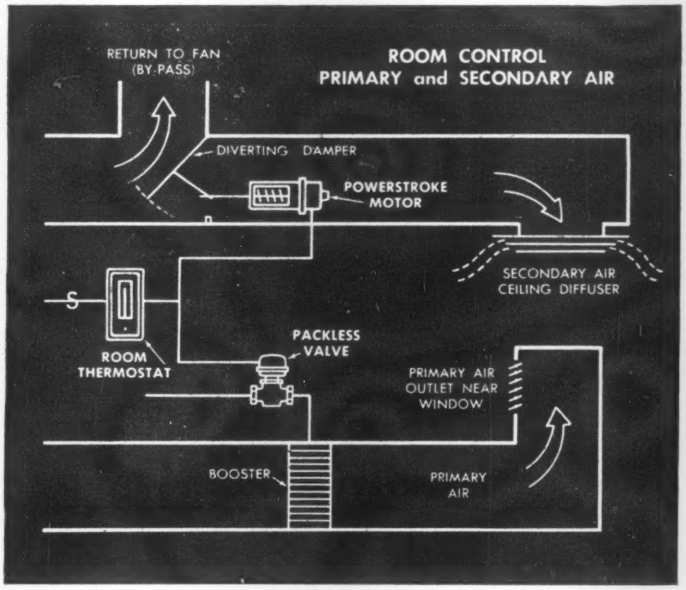


*Final check on the U. of K. Psychiatry Building's pneumatic control system by the consulting engineers, Wilson O. Kinney (left) and Arthur R. Scott.*



Heating, ventilating and air conditioning are accomplished through primary and secondary air systems. The primary system operates throughout the year, supplying a small amount of circulated air, including outside air. Final control in the primary system is a reheat coil — one for each patient room — using hot water with a Powers modulating packless valve.

Heart of the secondary — or booster — system is the automatic, quick-acting diverting damper. It permits both fresh and refrigerated air to pass into the individual rooms through a ceiling diffuser. When cooled air is not needed, it is diverted automatically by the damper into the ceiling plenum for return to the secondary fan.

To simplify individual room control of temperature, Scott & Kinney coordinated the actions of the reheat coil and the auto damper into a single control. One thermostat in each room controls both for maximum comfort.

This imaginative handling of standard Powers temperature control equipment is another example of problem-solving by the consulting engineer and the specialized help of Powers field engineers. The University of Kansas has reaped the benefits for the last four years — in comfort, operating economy and low cost maintenance.

*For more ideas and technical data on Powers pneumatic temperature control equipment and systems, write for the latest Powers Catalog.*

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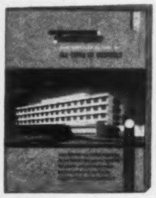

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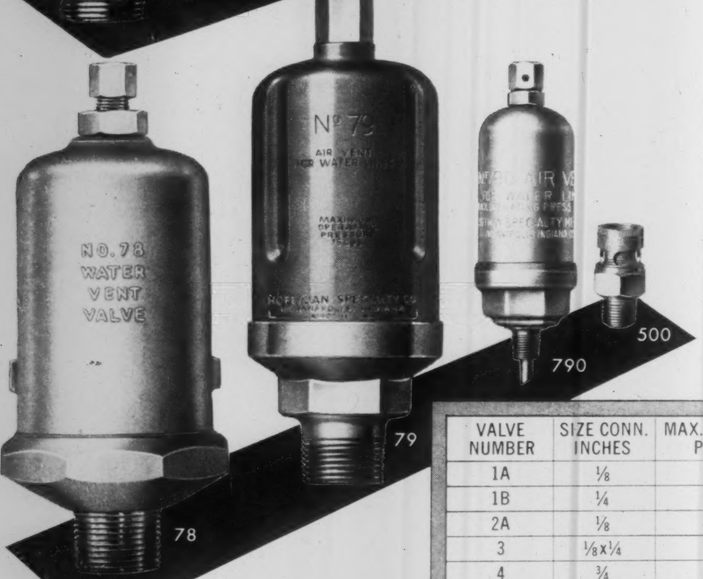
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| 2A | ⅛ | 10 | ■ | | ■ | | |
| 3 | ⅛x¼ | 25 | ■ | | ■ | | |
| 4 | ¾ | 25 | ■ | | | | ■ |
| 4A | ½x¾ | 10 | ■ | | | | ■ |
| 16A | ½x¾ | 10 | ■ | | | | ■ |
| 40 | ⅛ | 10 | ■ | | ■ | | |
| 41-43-45 | ⅛-¼-½x¾ | 10 | ■ | | | ■ | |
| 70A | ⅛ | 15 | ■ | | ■ | | |
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| 78 | ¾ | 150 | | ■ | | | ■ |
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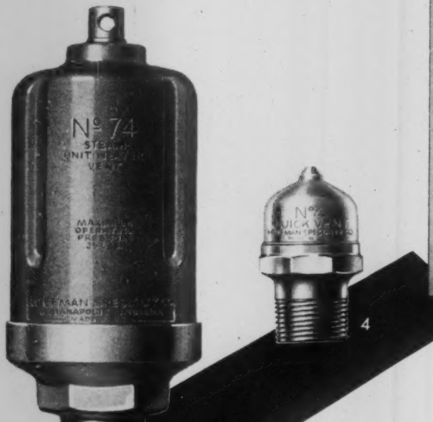
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# LETTER FROM THE EDITOR

September 1960

Dear Reader:

With two years of successful operation to prove the validity of the design, Neil Hill shows in his article on pages 93 to 102 how and why the heat pump reclaim system was designed for an office building in Oklahoma City. Mr. Hill explains the engineering reasoning behind the design and how all the factors were considered including weather data, the load variations, control and ventilation requirements, and the economy of using the heat pump reclaim cycle. Through careful balance of all internal heat gains with the load, it was found that supplemental heating would not be needed until the outside temperature dropped to 6.5 F. Electric heaters in the duct system are used in severe winter weather below this point. The complete analysis of this system presented by Mr. Hill in this article is worth your study.

Lester T. Avery reports more troubles with close fin spacing in his article on page 103. He shows what he has found in some installations after only one year's service. Have you experienced similar or different problems on the reduction of heat transfer because of too many fins?

While pressure and temperature requirements are the main factors in process piping design, special applications such as for ammonia piping can impose a variety of problems. Lowell G. Croysdale explains the special care taken in the design and fabrication of the ammonia piping systems for The Best Fertilizer Company plant in California in his article on pages 104 to 106. He points out the importance of cleanliness of the piping for ammonia and how this requirement was met. Prevention of leaks is another must. The methods and procedures used in designing, fabricating, and installing these piping systems have been proven through one year's operating experience.

Because individual tenant control was a primary factor in determining how the new Ten St. Mary Street building in Toronto should be heated and air conditioned, the architects and engineers and the owners decided to use two separate systems after considering all the factors. Steam turbine driven units with steam supplied from two packaged boilers were selected to provide the heating. Why and how this was done is explained by William Kitchen in his article on pages 107 to 110. When cooling is needed, supply air from air conditioning units on each floor is distributed in the ceiling space between the structural slab and the suspended metal pan acoustic ceiling. The cool air drops down through the perforations in the pans, thus achieving the desired comfort with low velocity air.

Many assumptions had to be made in the design of the industrial ventilation systems for a new heat treating and plating plant in Minnesota because no precedents existed for removing such high internal heat loads. Neil Hanson explains what was done in his article on pages 111 to 115. Now after two years of successful operation, the results can be reported which should be of help to other engineers and contractors with similar problems.

Because both low first cost and low owning and operating costs were essential requirements in selecting the method to air condition the new Traveler's Insurance Company building in Boston, it was decided to use self-contained units for heating and cooling. Lewis Smith explains how these units were selected in his article on pages 116 to 119.

Another report by John Collins of the National District Heating Association of their recent annual meeting is on pages 120 to 122. He tells in this article how remote controls lower manpower requirements and how Philadelphia has built a peak-load steam plant.

The data sheet on pages 123 and 124 includes a new alignment chart for estimating density, velocity head, and velocity of air and other gases.

More interesting results of the extensive corrosion investigation of copper and copper alloy tubing are presented on pages 125 to 133 by Dr. Obrecht and Dr Quill. They show this month how cupro-nickel and admiralty brass tubes offer better corrosion resistance against aggressive sodium-zeolite softened water when design conditions call for high velocities and high temperatures.

Designing air conditioning systems for aircraft, missiles, and rockets presents many different problems, and Robert Berner explains how the air cycle and vapor cycle systems have been applied to aircraft in his article on pages 134 to 138. The need for air conditioning of missiles and rockets to assure dependability is also shown in this article.

How the Air Force can improve the operation and maintenance of its many large heating systems is discussed in detail in this month's "HPAC Engineering Data File" on pages 141 to 156. This report has been prepared by Don Bahnfleth, Engineering Editor, who attended the recent Air Force Heating and Power Conference. It includes his summary of the papers and the discussions that took place there. While many of the remarks are based on Air Force experience and needs, all can be extrapolated and applied to civilian systems. Conservation, through proper operation and maintenance, was the theme of the conference. Engineers from 14 major commands and others exchanged experiences and considered ways to improve the efficiency and reliability of Air Force heating and power installations to reduce, if possible, the $148.5 million annual cost for operating and maintaining these systems.

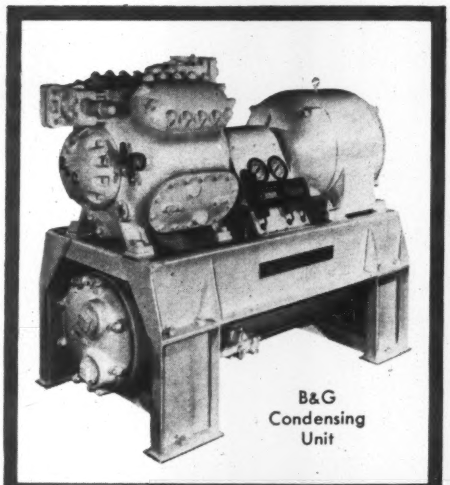
I hear many favorable comments from engineers and contractors alike about the "Open for Discussion" pages in each issue. This month these pages begin on 83. Your comments on the articles in these pages would undoubtedly be of interest to others too as much value comes from this exchange of experience.

You'll Want to Know is on pages 39 to 44 and contains news and other brief items of interest.

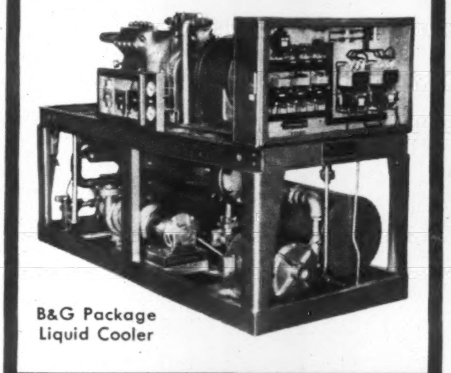
The second issue of the new Trade Literature Supplement (Part 2 of this issue) is included this month as a service to you. It is prepared for your convenience.

Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING

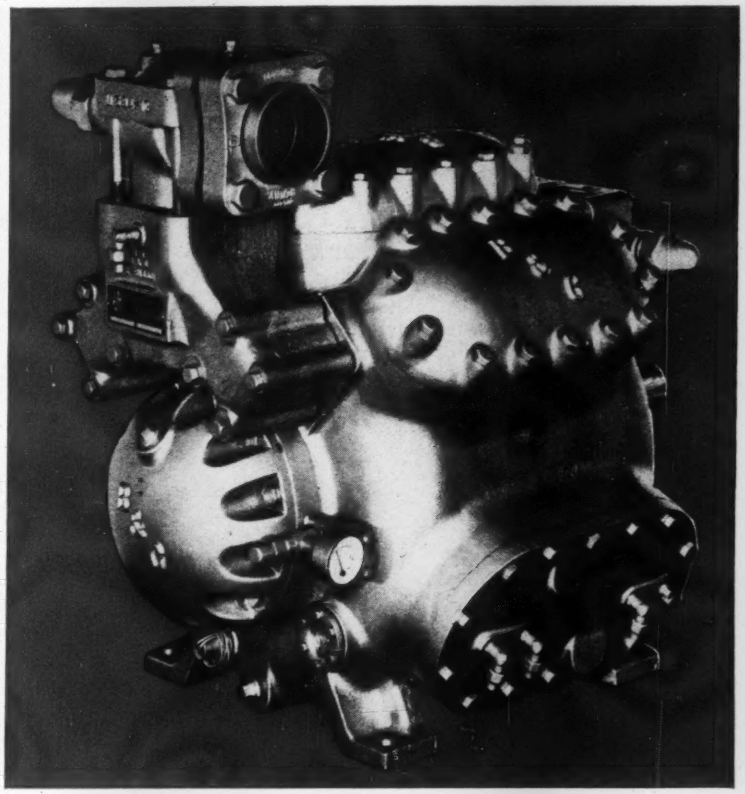


B&G Condensing Unit



B&G Package Liquid Cooler

All B&G Condensing Units and Package Liquid Coolers are equipped with B&G Compressors, shown here being assembled under controlled temperature and humidity conditions.



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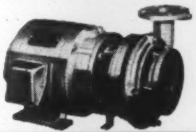

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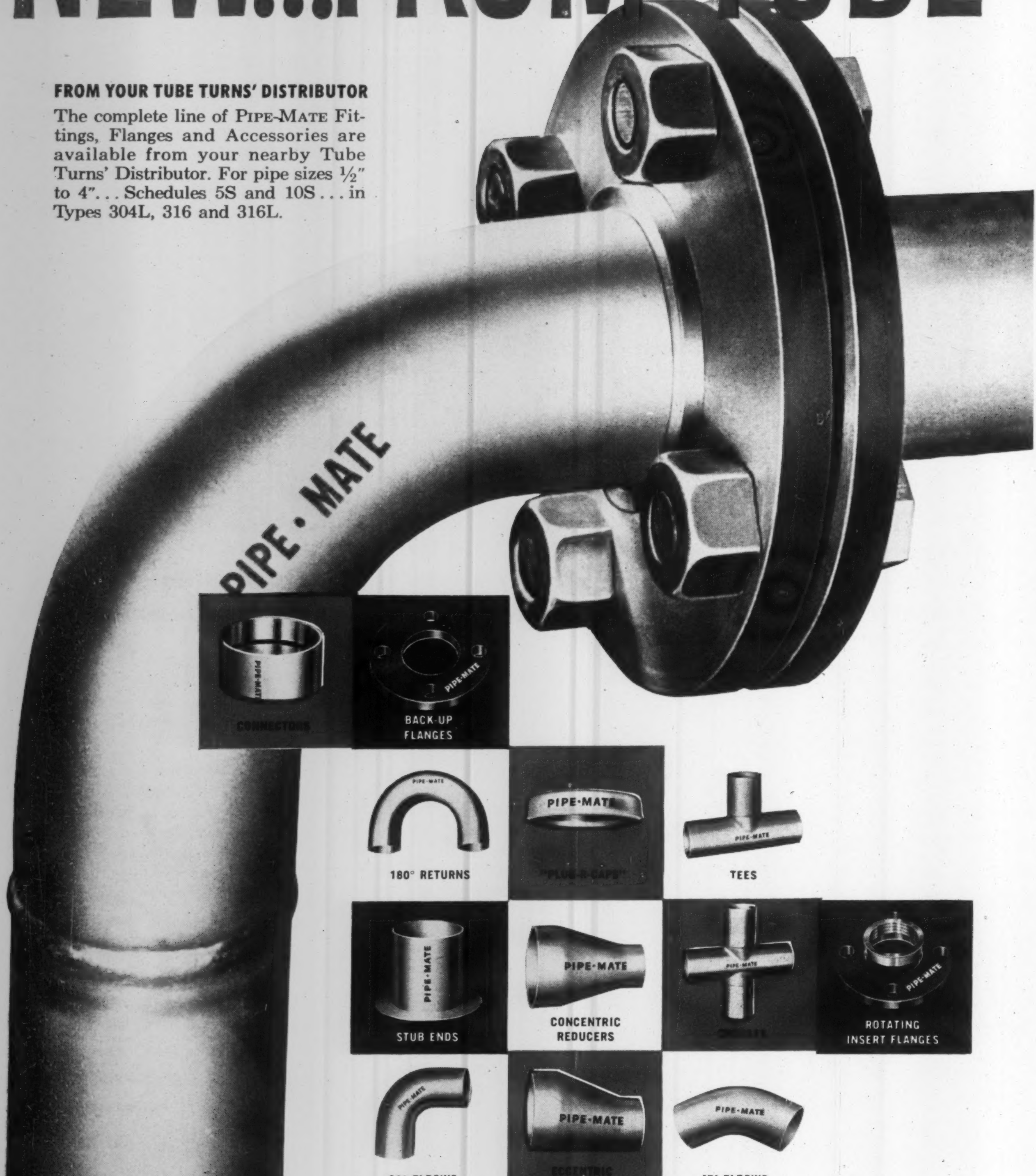
# NEW...FROM TUBE

**FROM YOUR TUBE TURNS' DISTRIBUTOR**

The complete line of PIPE-MATE Fittings, Flanges and Accessories are available from your nearby Tube Turns' Distributor. For pipe sizes ½" to 4"... Schedules 5S and 10S... in Types 304L, 316 and 316L.


PIPE • MATE
CONNECTORS
BACK-UP FLANGES
180° RETURNS
"PLUG-N-CAPS"
TEES
STUB ENDS
CONCENTRIC REDUCERS
CROSSES
ROTATING INSERT FLANGES
90° ELBOWS
ECCENTRIC REDUCERS
45° ELBOWS
PIPE-MATE

# TURNS...

## PIPE-MATE light-wall stainless steel fittings and flanges

Tube Turns introduces another important key to lower piping costs . . . a new line of light-wall stainless steel fittings and flanges for process piping. Here's how this PIPE-MATE* line reduces costs . . .

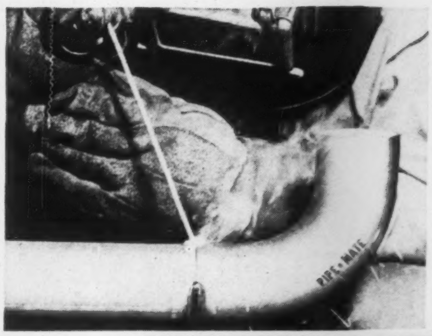
**Cuts material costs.** Compared to standard weight Schedule 40S pipe, *light-wall* piping in Schedule 5S or 10S cuts material costs as much as 30% to 50%. It weighs ½ to ⅓ as much, is easier to handle, easier to install and provides greater flow area.

**Simplifies installation.** Extra long tangents of PIPE-MATE fittings provide full straight-line clearance for fitting-to-fitting connections and permit fabrication of completely flanged elbows, returns, tees, etc. Aligning connector speeds making of socket type joints. Fittings may be butt-welded, fillet-welded, brazed or soldered, or joined by rolled-in flange connections.

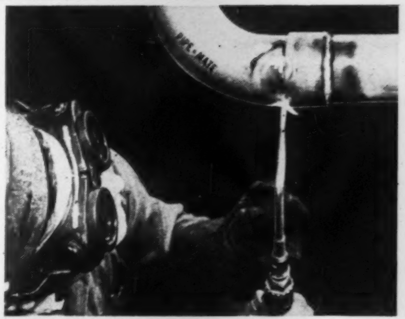
Here is another plus value you get when you specify products of Tube Turns and buy them from your Tube Turns' Distributor.

**FREE BULLETIN on PIPE-MATE** Fittings and Flanges describes complete line, shows installation procedures, and gives properties and dimensional tolerances. Mail coupon for copy.

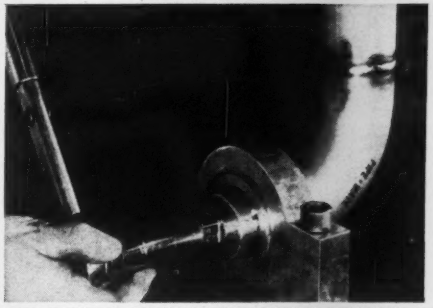
*"PIPE-MATE" and "tt" are trademarks of Tube Turns.



FOR BUTT-WELDING



FOR FILLET-WELDING, BRAZING OR SOLDERING



FOR ROLLED-IN FLANGED JOINTS

*Another tt plus value from...*

**TUBE TURNS**

DIVISION OF CHEMETRON CORPORATION

**Louisville 1, Kentucky**

CHEMETRON

DISTRICT OFFICES: Atlanta • Buffalo • Chicago • Columbus • Dallas • Denver Detroit • Houston • Kansas City • Los Angeles • Midland • New York Philadelphia • Pittsburgh • Richmond • San Francisco • Seattle • Tulsa
*In Canada:* TUBE TURNS OF CANADA LIMITED, Ridgetown, Ontario
*District Offices:* Edmonton • Montreal • Toronto
*In Mexico:* TUBE TURNS DE MEXICO, Mexico City

**TUBE TURNS**
**Department HP-9, 224 East Broadway**
**Louisville 1, Kentucky**
Please send bulletin TT944AR.

*Company Name* ________________

*Company Address* ________________

*City* ________ *Zone* ____ *State* ____

*Your Name* ________________

*Position* ________________

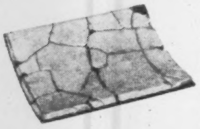
**With no lining at all**

Unlined steel heaters are subject to corrosion even under normal service.

**With plastic lining**

There is no known plastic or phenolic lining that will withstand temperatures required for hot water service.

**With ordinary concrete lining**



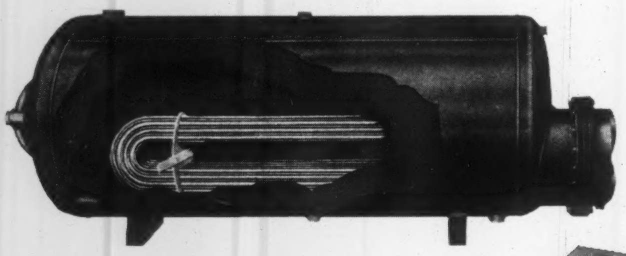
Plain steel plates soon lose protection, due to cracking and chipping. Cracks create localized corrosive cell spots.

# SPECIFY the only cement lining made exclusively for Storage Water Heaters...

# P-K PRE-KRETE®

Every cement-lined storage water heater bearing the P-K name-plate is factory-lined with Pre-Krete. Pre-Krete is completely uniform, without weak spots or "holidays," because it is thoroughly blended in special P-K equipment. It forms a strong, durable coating, ¾" thick, that prevents rust and corrosion, and provides high resistance to thermal shock. Pre-Krete will not chip, crack, or flake even at temperatures up to 900°F.

## You get a comprehensive guarantee on every P-K Storage Water Heater



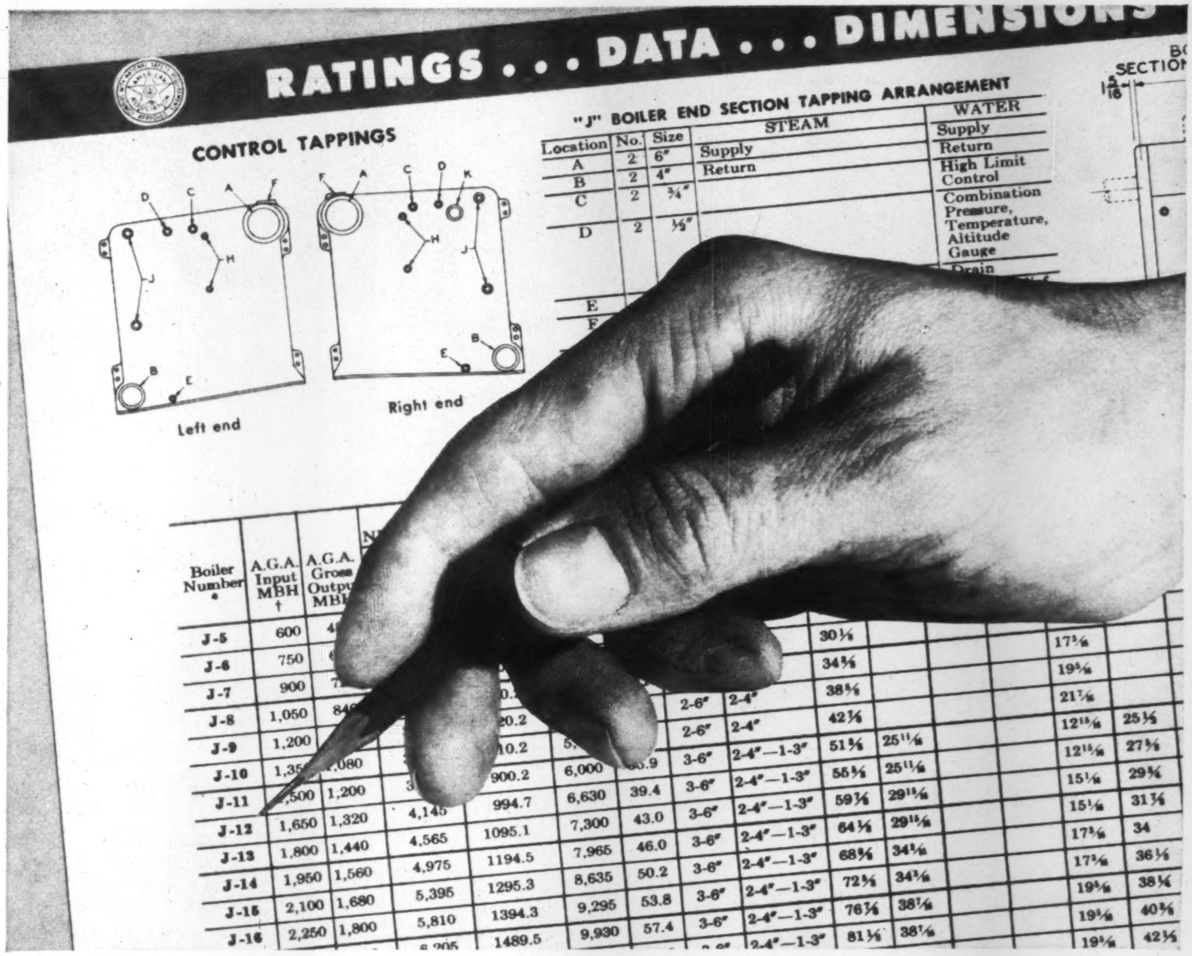
Every P-K Pre-Krete Lined Storage Water Heater is fully lined including manhole, cover plate and heating element nozzle.

Specify P-K Pre-Krete lined and you get a storage water heater on which all materials and workmanship are fully guaranteed to be first-class in every respect, and you have the P-K assurance that every heater bearing its name will heat its rated capacity of water. For full details, write for your copy of Catalog Number 19 to Patterson-Kelley, 102 Burson Street, East Stroudsburg, Pennsylvania.

2

**Patterson Kelley**
**Water Heater Division**

**storage water heaters • instantaneous heaters • convertors • water to water exchangers**



"J" BOILER END SECTION TAPPING ARRANGEMENT

| Location | No. | Size | STEAM | WATER |
|---|---|---|---|---|
| A | 2 | 6" | Supply | Supply |
| B | 2 | 4" | Return | Return |
| C | 2 | ¾" | | High Limit Control |
| D | 2 | ½" | | Combination Pressure, Temperature, Altitude Gauge |
| | | | | Drain |
| E | [illegible] | [illegible] | [illegible] | [illegible] |
| F | [illegible] | [illegible] | [illegible] | [illegible] |

| Boiler Number * | A.G.A. Input MBH † | A.G.A. Gross Output MBH | N[illegible] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| J-5 | 600 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 30⅛ | | | | 17 5/16 | |
| J-6 | 750 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 34⅜ | | | | 19 5/16 | |
| J-7 | 900 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 2-6" | 2-4" | 38⅝ | | | | 21 7/16 | |
| J-8 | 1,050 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 2-6" | 2-4" | 42⅞ | | | | 12 15/16 | 25½ |
| J-9 | 1,200 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3-6" | 2-4"—1-3" | 51⅜ | 25 11/16 | | | 12 15/16 | 27⅝ |
| J-10 | [illegible] | [illegible] | [illegible] | 900.2 | 6,000 | [illegible] | 3-6" | 2-4"—1-3" | 55⅝ | 25 11/16 | | | 15 1/16 | 29¾ |
| J-11 | [illegible] | 1,200 | 4,145 | 994.7 | 6,630 | 39.4 | 3-6" | 2-4"—1-3" | 59⅞ | 29 15/16 | | | 15 1/16 | 31⅞ |
| J-12 | 1,650 | 1,320 | 4,565 | 1095.1 | 7,300 | 43.0 | 3-6" | 2-4"—1-3" | 64⅛ | 29 15/16 | | | 17 3/16 | 34 |
| J-13 | 1,800 | 1,440 | 4,975 | 1194.5 | 7,965 | 46.0 | 3-6" | 2-4"—1-3" | 68⅜ | 34 3/16 | | | 17 3/16 | 36⅛ |
| J-14 | 1,950 | 1,560 | 5,395 | 1295.3 | 8,635 | 50.2 | 3-6" | 2-4"—1-3" | 72⅝ | 34 3/16 | | | 19 5/16 | 38¼ |
| J-15 | 2,100 | 1,680 | 5,810 | 1394.3 | 9,295 | 53.8 | 3-6" | 2-4"—1-3" | 76⅞ | 38 7/16 | | | 19 5/16 | 40⅜ |
| J-16 | 2,250 | 1,800 | 6,205 | 1489.5 | 9,930 | 57.4 | [illegible] | 2-4"—1-3" | 81⅛ | 38 7/16 | | | 19 5/16 | 42½ |

## 33 GAS BOILER SIZES IN 500 sq. ft. INCREMENTS PREVENT OVERSIZING WASTE

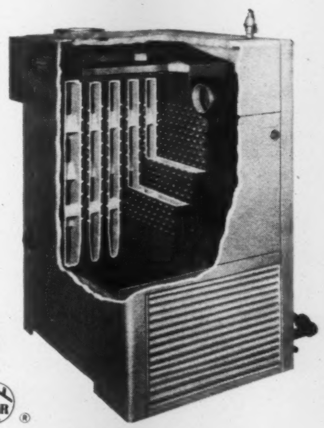
Oversizing a boiler because of inability to closely match boiler capacity to heating load increases operating cost and required boiler room space.

In Weil-McLain Type "J" Gas Boilers, the flexibility of cast iron sectional construction has permitted the design of a complete line of boilers *with sizes increasing in steps of only 500 gross sq. ft. each!*

Close sizing is only one of the ways in which a "J" Boiler saves money. For example, a high chimney, or forced or induced draft are not necessary for proper operation...all "J" boilers can operate with only a vent. And rating for rating, a "J" boiler takes less boiler room space than a typical scotch marine boiler.

**Other *"extra values"***

**A.G.A. approved efficiency of 80%...available with A.G.A. approved dual fuel manifold...Electronic controls and pre-wired control panels are engineered as part of unit...no refractories, motors, fans, tubes or water treatment.**



**TYPE "J" GAS BOILER**
**Net I=B=R Capacities:**
**360,100—3,354,000 BTU/hr.**
**Send for Bulletin C-297**

**WEIL-McLAIN**
**CAST IRON BOILERS**

WEIL-McLAIN COMPANY • Dept. AA-90 • MICHIGAN CITY, INDIANA

CAPITOL PIPE

WORLD-WIDE

**Capitol**

**PIPE & STEEL PRODUCTS, INC.**

*announce the addition of a*

**NEW INVENTORY PRODUCT**

---

**SEAMLESS NICKEL ALLOY PIPE ASTM**

**A333 GRADE 3 (3½% NI.)**

---

Now a stocking source for this **heretofore hard to get item.** Designed to meet your low-temperature piping requirements, to minus 150° Fahrenheit. Stock sizes range from ½ IPS to 16" OD in Standard and Extra Heavy wall thicknesses. No minimum mill quantities with costly over-runs; no lengthy deliveries. . . .

**Immediate out of stock shipments.**

**We invite your inquiries.**

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1275 Suburban Station Building
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JAckson 6-4761
TWX TO HOUSTON HO 373U

**Performance makes the world of difference**

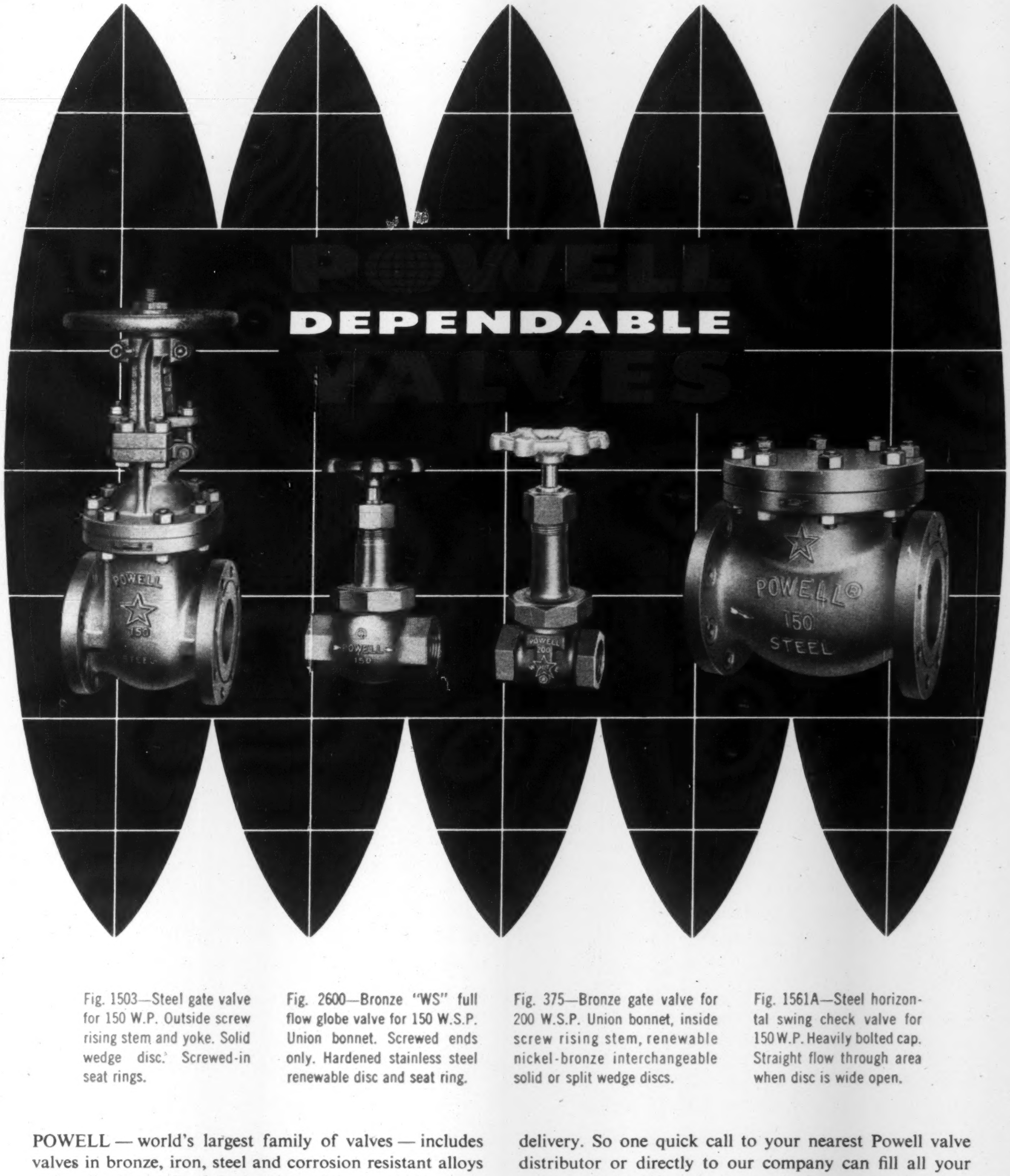


Fig. 1503—Steel gate valve for 150 W.P. Outside screw rising stem and yoke. Solid wedge disc. Screwed-in seat rings.

Fig. 2600—Bronze "WS" full flow globe valve for 150 W.S.P. Union bonnet. Screwed ends only. Hardened stainless steel renewable disc and seat ring.

Fig. 375—Bronze gate valve for 200 W.S.P. Union bonnet, inside screw rising stem, renewable nickel-bronze interchangeable solid or split wedge discs.

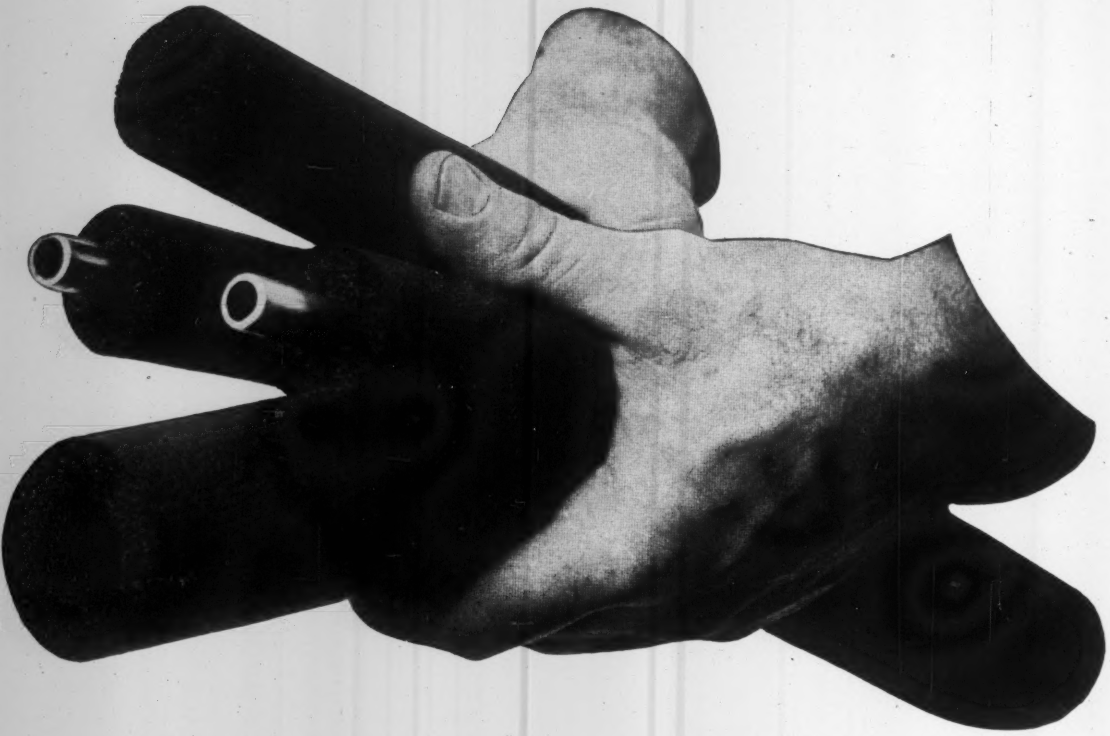
Fig. 1561A—Steel horizontal swing check valve for 150 W.P. Heavily bolted cap. Straight flow through area when disc is wide open.

POWELL — world's largest family of valves — includes valves in bronze, iron, steel and corrosion resistant alloys to handle the needs of the heating, piping, and air conditioning industry.

All types are available—most in stock for immediate delivery. So one quick call to your nearest Powell valve distributor or directly to our company can fill all your valve needs. And if you have a special flow control problem, our engineers will help you solve it to your complete satisfaction. Contact us—TODAY!

**Powell . . . world's largest family of valves**

THE WM. POWELL COMPANY • DEPENDABLE VALVES SINCE 1846 • CINCINNATI 22, OHIO



## Protect profits from call-back expense . . . insulate hot and cold water lines with

## Press-O-Cel:®

*the lightweight, flexible, closed cell insulation*

PRESST-O-CEL not only insulates equal to or better than glass fibre, wool, cellular rubber, corkboard, rigid plastics and others . . . *it has built-in protection for itself!*

- Internal oxidation and deterioration are prevented by millions of inert gas cells.
- Will not get brittle from prolonged heat exposure.
- Use on hot lines to 220° F., cold lines to −40° F.
- Non-inflammable, will not conduct flame.
- Install below grade—fungus and vermin resistant, impervious to moisture, will not rot.
- Use on weather-exposed lines with simple external treatment.
- Flexible, lightweight, fast and easy to install.

*WRITE TODAY for sample and data. Address Dept. B-22.*

PRESSTITE SEALING COMPOUNDS

**PRESSTITE DIVISION**
AMERICAN-MARIETTA COMPANY
A-M

3792 CHOUTEAU AVE • ST. LOUIS 10, MO.

6090

## TACO Stocks your Custom-Built Pumps!

That's right. By specifying any *standard* TACO "LP" pump, with its many options, you can actually order a custom-designed, single stage centrifugal pump to precisely meet your requirements!

For Hospital applications, for example, specify any standard "LP" with sleeve bearings and quiet motor. For industrial applications merely specify the *same* "LP" with ball bearings and a regular motor.

And, just as easily, you can specify an "LP", base-mounted or close-coupled . . . with mechanical seals or stuffing boxes, with or without cooling jackets . . . shafts or shaft sleeves in stainless steel and so on. What's more, every "LP" provides many extras, such as advanced design throttle bushing, oil slinger ring lubrication, centerline discharge and many more. Get complete specifications . . . specify "LP". All products in the broad TACO line are "efficiency engineered" to provide maximum performance and economy on all your installations. Write TACO HEATERS, INCORPORATED, 1160 Cranston Street, Cranston 9, R. I.

**TACO**

*SERVING THE HYDRONIC INDUSTRY SINCE 1920*

# *For the first time!*

## Everything you need in Dial Thermometers for Piping *and* Duct work!

A new and complete line of instruments: Dial thermometer of Marsh precision and accuracy designed down to the last detail for piping and duct work . . . for use on heating and cooling equipment, air ducts, vessels and kilns, ovens and similar applications.

### *Easier to read*

Illustrations tell the story. Four types, seven ranges—72 stock combinations to meet every condition. Big, legible 3½" and 4½" dials . . . easy to read in places where piping and duct thermometers must be installed. Ease of reading further increased by provision for tilting and turning dials to any desired reading angle. Line includes distant reading types that take care of remote locations.

### *Unbreakable—more accurate*

Instead of fragile difficult-to-read glass tube thermometers you now have sturdy, unbreakable, legible Marsh Dial Thermometers. Guaranteed accurate to plus or minus one division of the scale, they have far greater *readable* accuracy than any glass tube type. All have the famous Marsh "Recalibrator"—to *keep* them accurate.

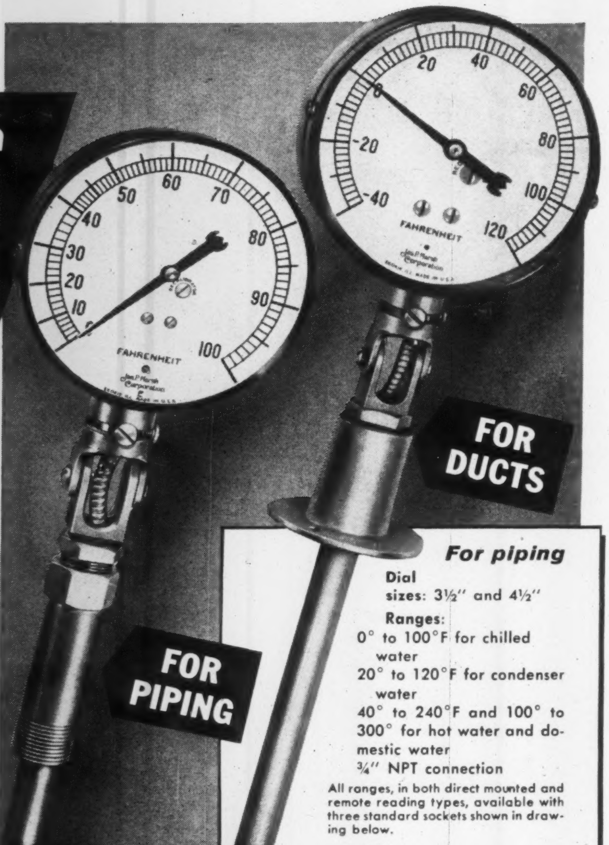
### *All purpose*

Design provides for every on-the-job condition. Separable sockets ("wells") simplify installation—or removal for servicing. Extension necks take care of insulation on piping or ducts. Long stems in duct type put temperature-sensitive section where it belongs.

*Note the brief specifications opposite. Any thermometer is available from stock.*

***Write for bulletin telling the whole story.***

**Marsh Instrument Company**
Division of Colorado Oil and Gas Corporation
**Dept. T, Skokie, Ill.**
Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd Street, Edmonton, Alberta

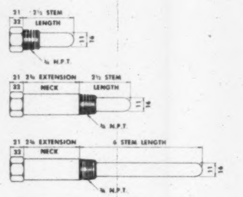


### *For piping*

**Dial sizes:** 3½" and 4½"

**Ranges:**
0° to 100°F for chilled water
20° to 120°F for condenser water
40° to 240°F and 100° to 300° for hot water and domestic water
¾" NPT connection

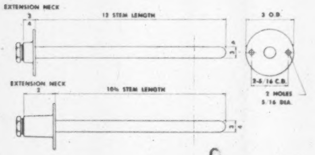
All ranges, in both direct mounted and remote reading types, available with three standard sockets shown in drawing below.

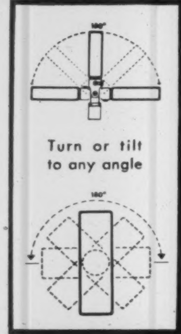


### *For ducts*

**Dial sizes:** 3½" and 4½"
**Ranges:** —40° to +120° F
0° to 160° F
0° to 220° F

All ranges, in both direct mounted and remote reading types, available with standard extension necks and stems shown in drawing below.





Turn or tilt to any angle

# MARSH

## DIAL THERMOMETERS

### *Also remote reading—*

Piping and duct thermometers of same basic design available with 6 ft. of capillary tubing as shown.

# "Best valve made for air conditioning!"

**Dial Indicator for Balancing Rectangular, Diamond or V Ports**

All ACF Plug Valves may be equipped with dial indicators, which save time and inconvenience in recovering proper balance in air conditioning systems.

In addition to the popular rectangular port, ACF Plug Valves are also available in diamond and V port models for even more accurate flow control.

**Product of W-K-M's**
*Creative Engineering*

## acf® Plug Valves

ACF lubricated plug valves give positive control at minimum expense for air handlers, compressing units, natural gas or fuel oil lines, and water towers.

No matter how long between operations, ACF plug valves open and close with an easy quarter-turn. Friction surfaces are constantly lubricated for smooth turning and protection against corrosion. A teflon gasket backed-up by a lubricant reservoir seals the head seat. The cylindrical plug — with a well-proportioned full pipe area port — provide an effective seal in the line.

Next time — and every time — specify ACF! *Available from leading suppliers everywhere.*

**WRITE FOR BULLETIN AP-1059**

W-K-M

DIVISION OF acf INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

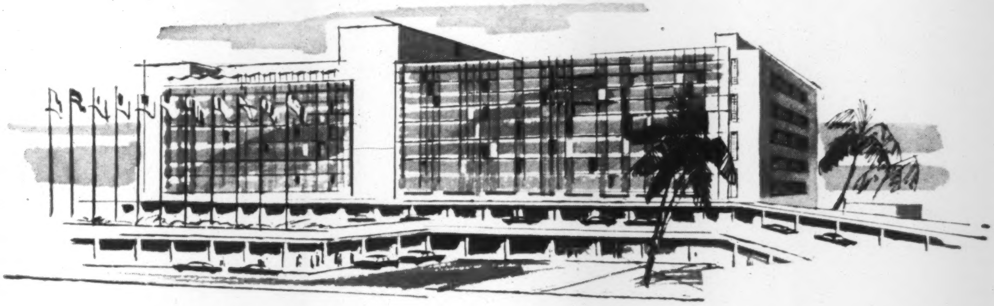
5924

**Mr. Ed Smith, Miami Manager, The Poole & Kent Company, Mechanical Contractors, says:**

# "Honeywell service really Miami International

Mr. Smith on the airport observation deck overlooking the Miami International Airport Hotel. Honeywell temperature control in the hotel keeps travelers as comfortable as possible.

# paid off for us on the Airport Hotel job”



*Architect: Steward-Skinner Associates*
*Consulting Engineer: Mitchell-Gordon Associates*
*General Contractor: Fred Howland, Inc.*
*Mechanical Contractor: The Poole & Kent Company*

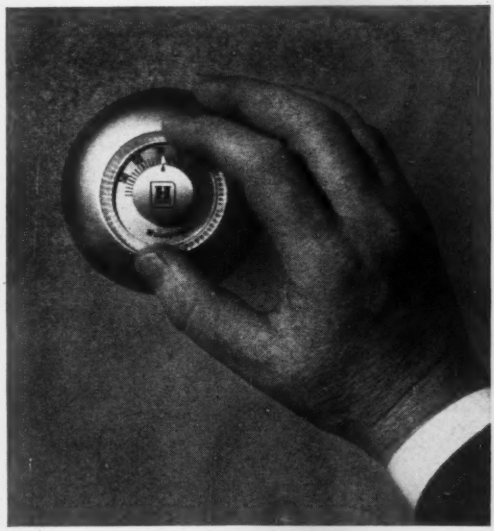
## Engineers from Honeywell's Miami office were always available and eager to help

"When we installed the Honeywell temperature control system at the Miami International Airport Hotel," says Smith, "Honeywell men were ready to handle any problem encountered. But Honeywell engineers had planned the system so well, we were easily able to maintain job progress."

According to Smith, "This is very important to our operation. Accurate shop drawings . . . the right equipment . : . there can't be a slip-up, or unprofitable delays will be encountered. This isn't likely to happen with Honeywell men on the job. Honeywell supervises a job from start to finish; and the equipment is the best available."

You get more to work with when you work with Honeywell. Easily installed controls, accurate specifications, prompt delivery and excellent supervision are the advantages enjoyed by every contractor with Honeywell on his team.

Call your local Honeywell office for details. There are 112 conveniently located across the nation. Or write Honeywell, Dept. AC-9-116, Minneapolis 8, Minnesota. In Canada, contact Honeywell Controls, Limited, Toronto 17, Ontario.



The Honeywell temperature control system installed in the hotel includes 270 individual room thermostats.

**Honeywell**

*First in Control*

SINCE 1885

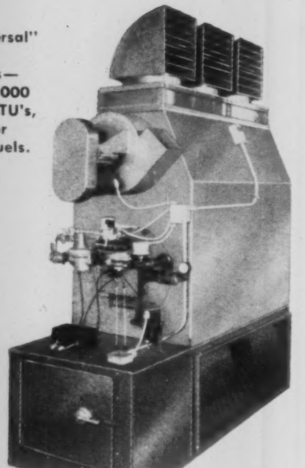
75th YEAR PIONEERING THE FUTURE

Sales and service offices in all principal cities of the world. Manufacturing in the United States, United Kingdom, Canada, Netherlands, Germany, France and Japan.

# BE CONFIDENT

for space heating **CALL NATIONAL**

TOTAL DESIGN
UNITIZED HEATERS



National "Universal" Series ITD, 6 Styles, 96 Sizes—Capacities 400,000 to 4,000,000 BTU's, with Gas, Oil or Combination Fuels.

**Whatever your heating problem – National has the answer!**

National produces the industry's largest number of heater styles and sizes! Because there's a National Champion for *every* heating requirement, you get the *right* heater to do the *best* job.

And *only* National offers "Total Design" heaters as well as conventional packaged heaters. With "Total Design" every component *including the burner* is custom-*designed* and *built* by National. This means *higher efficiency, greater economy, less maintenance* and just *one* source of responsibility. And National Champions feature heat and corrosion resistant metals throughout *all* units for dependable long life.

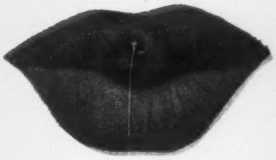
Make the *right* heating decision, before *you* specify, check National and . . .

*select with confidence!*

**NATIONAL HEATER COMPANY, INC.**

**2475 DOSWELL AVE., ST. PAUL 8, MINN., TELEPHONE: MIDWAY 6-9631**

New Airfoil Bladed Fans



Whisper

Here's a completely new line of Airfoil Bladed Fans from American-Standard Industrial Division with an exclusive radial rim wheel design that substantially lowers air velocity through the blast area of the wheel. This new design, plus airfoil blading, reduces turbulence and results in unusually quiet fan operation. Exceeding 90% in mechanical efficiency, American-Standard* Airfoil Fans are ideal for both general ventilation and industrial process applications. And every one carries the AMCA certified rating seal. Get all the facts. Send for Bulletin A-1103 today. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario. *AMCA Certified Ratings*

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation

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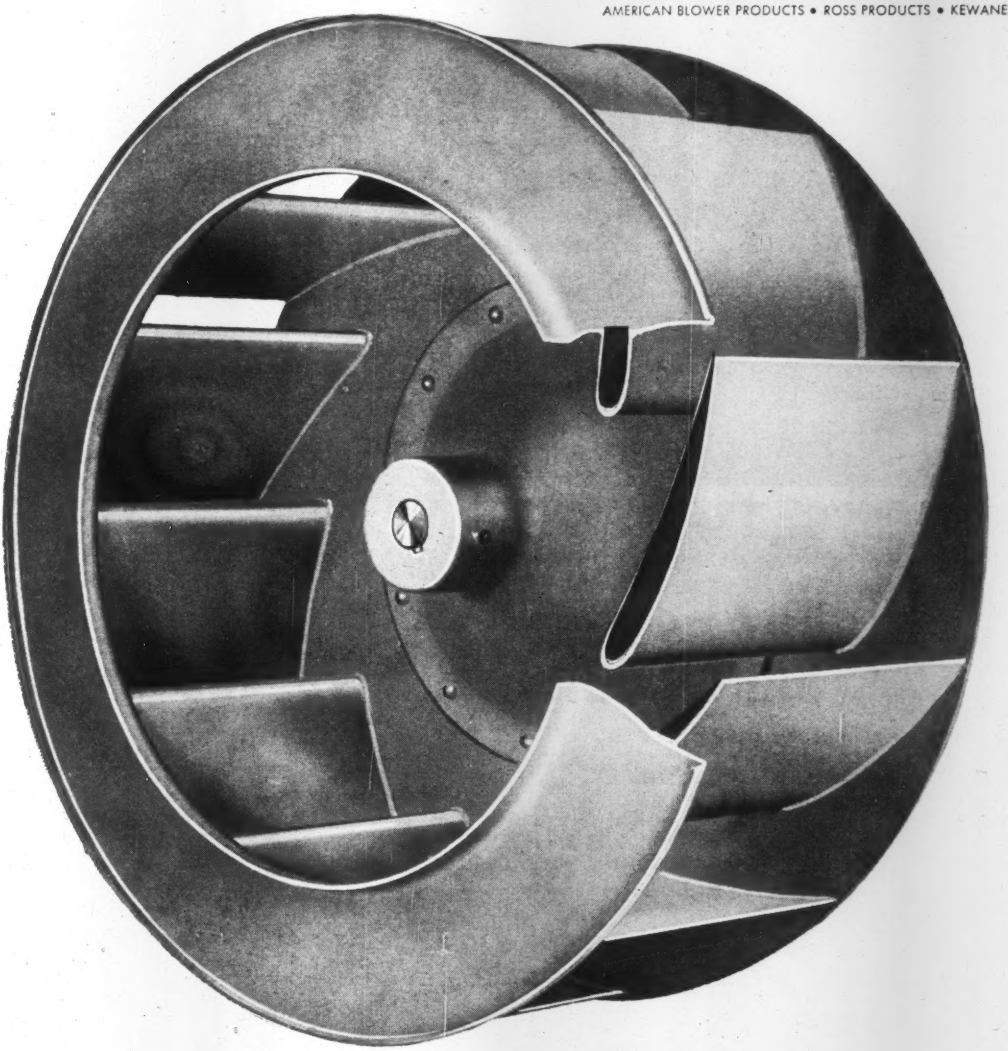
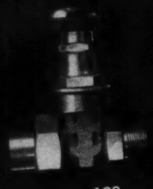
INDUSTRIAL DIVISION
AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS



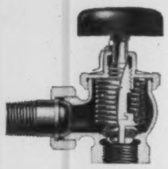
No. 127
Convector Gate Valve. Also available with sweat connections

No. 170
Radiator Gate Valve

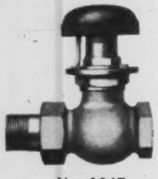
No. 2201 Heavy Duty Globe Valve, with sweat connections; angle pattern also available



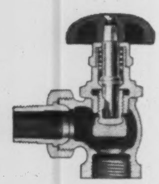
No. 129
Convector Gate Valve with Packless Bonnet. Also available with sweat connections



No. 45A
Radiator Valve, Modulating Type



No. 1247
Modulating Globe Valve

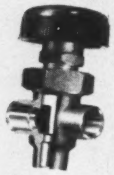


No. 1137
Quick Opening Angle Valve

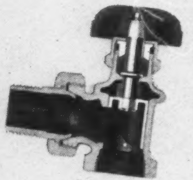
No. 1241
Quick Opening Corner Pattern

2960

No. 1103 Mill Supply Globe Valve



No. 2357
Heavy-duty 3-way Sweat Valve



No. 157
Sleeve-type Water Valve

Type 20 Sarcoflow Balancing Fitting

## FOR STEAM HEATING • RADIANT HEATING • HOT WATER HEATING • AIR CONDITIONING

# SARCO RADIATOR VALVES

You can meet your most exacting needs in radiator valves with Sarco. For steam: Bellows-Packless, Spring-Packless, and Gland-Packed. For hot water; Spring-Packless and Gland-Packed. Made in globe and gate types, angle and corner patterns, modulating and quick opening. Sizes from ⅜″ to 2″, pressures up to 200 psi.

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of the new Bulletin No. 225, covering radiator valves, balancing fittings, and access boxes, with sizes, capacities, and roughing-in dimensions.

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SARCO COMPANY, INC.
AN AFFILIATE OF SARCOTHERM CONTROLS, INC.
635 MADISON AVENUE, NEW YORK 22, N.Y.
PLANT: BETHLEHEM, PA.

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## . . . AT NO EXTRA COST!

Compare these money-saving Midwest Long Tangent elbows (one of five types offered) with ordinary long radius ells! The Long Tangent type provides 21% greater length on 90° ells, 42% more on 45° ells. Only Midwest gives you this bonus *at no extra cost!*

Long Tangent elbows save time and money in many ways: (1) they save on pipe; (2) they save by eliminating short nipples and extra welds; (3) they save time in applying slip-on flanges or sleeves; (4) they save time in lining-up and clamping pipe; and (5) it is easier to replace an ordinary ell with a Midwest Long Tangent than with another ASA ell.

Only Midwest manufactures and stocks Long Tangent ells in a complete size range through 36″. Also available with special tangent lengths at slight additional charge.

Write for catalog which shows complete selection of Midwest welded-type and seamless fittings.

*Sold through Stocking Distributors from Coast to Coast*

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**MIDWEST PIPING COMPANY, INC.**
*1450 S. Second Street St. Louis 4, Missouri*

*THE WORLD'S MOST COMPLETE LINE—*
*SEAMLESS AND WELDED-TYPE FITTINGS*

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Woodland School, Weston, Mass. Architect, Hugh A. Stubbins Associates, Inc.; Engineer, Fred S. Dubin, Associates. Forced warm air supplied by two oil-fired Campbell 8000 Series Heaters. Hot and cold air supplied separately at high velocity to each classroom where automatic mixing provides desired temperature.

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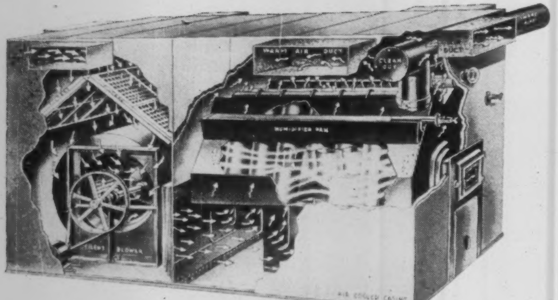
Campbell Warm Air Heaters are especially adaptable for school heating. They provide fast heat delivery; positive control of temperature, humidity and ventilation; quiet operation, and outstanding fuel economy. Campbell Heaters are compact, easy to install, exceptionally trouble-free, and surprisingly low in cost. Available for all fuels in capacities up to 3,150,000 BTUs.



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We have some attractive openings for men calling on heating contractors and architects.

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**HEATING COMPANY**

Des Moines 17, Iowa

# Make Allen-Bradley your one source for trouble free

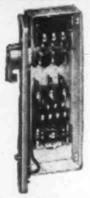
# AIR CONDITIONING CONTROLS

More and more "men who know" in the air conditioning field are "standardizing" on Allen-Bradley for *all* their control needs, because they can be confident of dependable performance. For example, the popular Bulletin 709—the heart of the A-B starter line—has a simple, one moving part solenoid design that assures millions of trouble free, maintenance free operations. It's the *one* starter you can install . . . and forget. Insist on A-B motor control—and your control troubles will disappear.

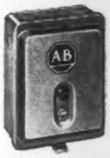
A-B QUALITY

## FULL VOLTAGE STARTERS

**SOLENOID STARTER**
Made in 9 sizes with ratings to 450 hp, 220 v; 900 hp, 440-550 v.
**Bulletin 709**

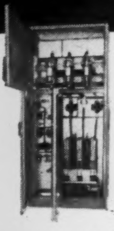


**COMBINATION STARTER**
Has manual disconnect switch. Ratings to 100 hp, 220 v; 200 hp, 440-550 v.
**Bulletin 712**



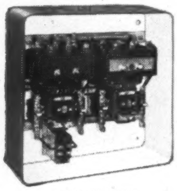
**MANUAL STARTER**
Rugged snap action switch assures long life. Ratings to 7½ hp, 600 v.
**Bulletin 609**

**SMALL MOTOR STARTING SWITCH**
With dependable overload breaker. Rated 1 hp.
**Bulletin 600**



**HIGH VOLTAGE STARTER**
Has rugged air break contactor. Ratings to 1500 hp, 2300 v; 2500 hp, 4600 v.
**Bulletin 1159**

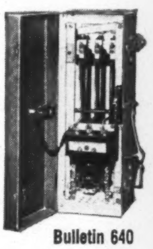
## REDUCED VOLTAGE STARTERS



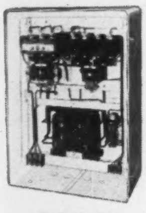
**Bulletin 736**

◀ **PART WINDING STARTER**
For induction motors with separate parallel stator windings. Ratings to 600 hp, 220 v; 1200 hp, 440-550 v.

**MANUAL RESISTANCE STARTER** ▶
Graphite disc resistors provide velvet smooth acceleration. Ratings to 200 hp, 220-440-550 v.



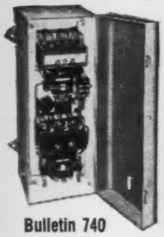
**Bulletin 640**



**Bulletin 746**

**AUTOMATIC RESISTANCE STARTER** ▶
Graphite disc resistors automatically inserted during starting for velvet smooth acceleration. Ratings to 200 hp, 220-440-550 v.

◀ **AUTOMATIC AUTOTRANSFORMER STARTER**
Limits current inrush during starting of squirrel cage motors. Rated to 300 hp, 220 v; 600 hp, 440-550 v.

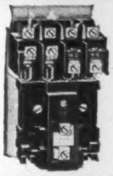


**Bulletin 740**

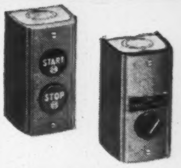
## CONTROL ACCESSORIES

**TEMPERATURE CONTROLS**
Precision snap action switch prevents contact chatter. Rugged, compact unit. Operating ranges — 150°F to 490°F.
**Bulletin 837**

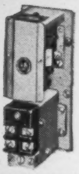
**PRESSURE CONTROLS**
Positive contact operation, unaffected by vibration or mounting angle. Operating ranges 30″ vacuum (Hg) to 900 psi.
**Bulletin 836**



**CONTROL RELAYS**
New Type BR above has convertible contacts. Types B, general purpose; and BX, universal, relays available.
**Bulletin 700**



**PUSH BUTTON STATIONS**
Wrap-around cover cuts wiring time. Selector switch can be quickly converted for two- or three-way service.
**Bulletin 800**



**TIMING RELAYS**
Easily adjustable from 1/20 to 180 sec ± 10%. Can be changed in the field for ON-DELAY or OFF-DELAY operation.
**Bulletin 849**

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***QUALITY MOTOR CONTROL***

# CARNES*

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NEW
ACOUSTIC
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FOR
ALL-AIR
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SYSTEMS

**SIMPLIFIED DESIGN . . .**
*LICKS SERVICE PROBLEMS*

**Eliminates**

- Curtains
- Linkages
- Flappers
- Pulleys
- Sliding Bases
- Bladders
- Cables
- Pivots
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- Split Service Responsibility

*** OFFERS ALL THESE FEATURES . . .**

- Positive Temperature Mixing with Integral Blender
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- Leading Edges of Lining Metal-Protected
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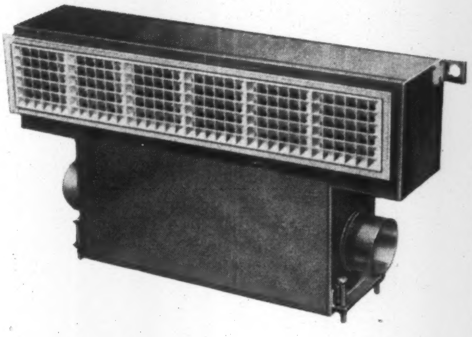

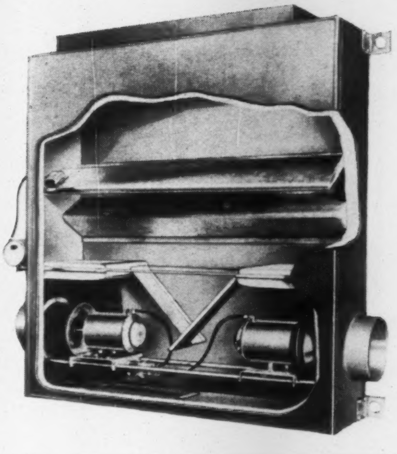

*

## 3 CEILING MODELS

*6 sizes*

- End Discharge
- Bottom Discharge
- Multi Discharge

## 2 WINDOW PERIMETER MODELS

*3 sizes with Linear, Curtainaire or New Modular Diffusers*

- Front Discharge
- Top Discharge

*

## NEW SIMPLIFIED ALL-PNEUMATIC CONSTANT VOLUME CONTROL . . .

*with Direct Valve-to-Motor Connection*

*Elimination of mechanical devices such as curtains, flappers, bladders assures trouble-free, lifetime operation.*

- No Split Service Responsibility
- No Binding or Lost Motion
- No Lubrication or Cleaning
- No Short Circuiting

**ALL MODELS AVAILABLE IN SINGLE OR DUAL DUCT**

*with Full Control Selection*

- Dual Duct, Pneumatic Constant Volume Control
- Dual Duct, Manual Volume Control
- Single Duct, Pneumatic Valve Control
- Single Duct, Manual Valve Control

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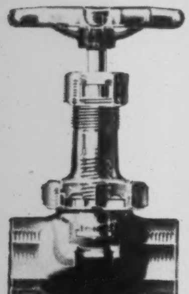
CARNES CORPORATION
VERONA, WISCONSIN

**The LUNKENHEIMER Valves in your competitor's plant or building are the valves that cost you most!**

With quality Lunkenheimer Valves in his plant or building, your competitor enjoys far fewer leakage, production and maintenance losses. Thanks to these savings, he lowers his costs . . . and makes more profit. Why give him this important advantage? Install Lunkenheimer Valves . . . famous for quality and performance for nearly a century. The Lunkenheimer Co., Cincinnati 14, Ohio.

**You can't find the cost of a valve on a price list.**



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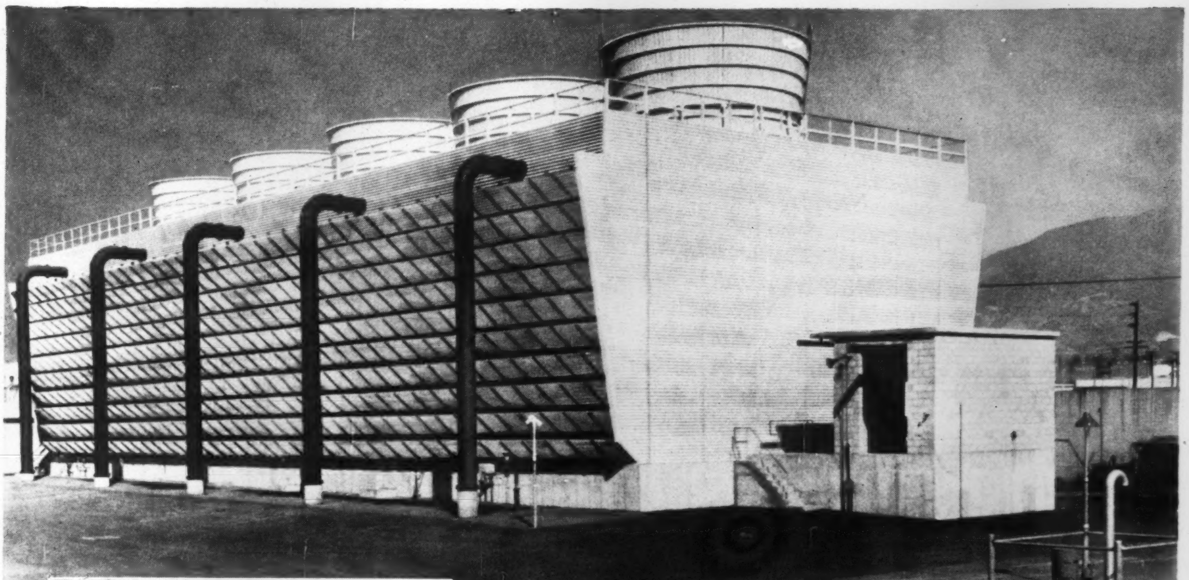
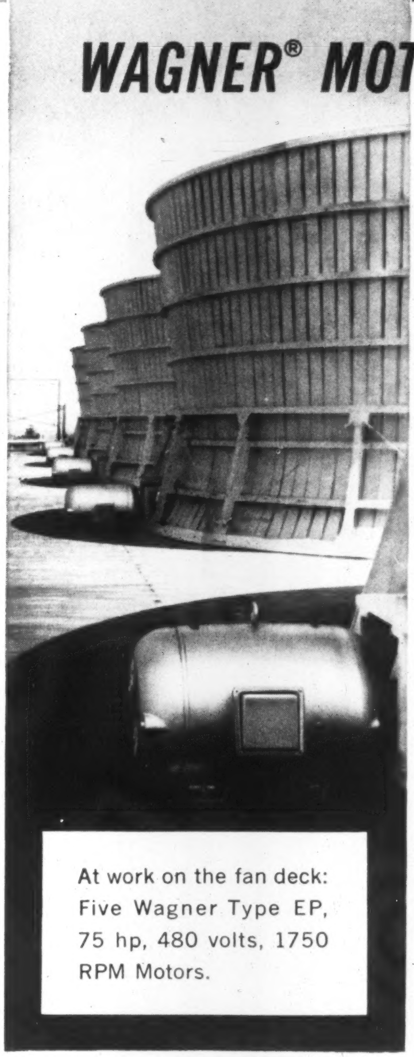
- IRON
- STEEL
- PVC

LUNKENHEIMER®
THE ONE *Great* NAME IN VALVES

L-460-6D





At work on the fan deck: Five Wagner Type EP, 75 hp, 480 volts, 1750 RPM Motors.

# WAGNER® MOTORS HELP MARLEY TOWER

## PRODUCE *MORE POWER* FOR BURBANK

This is the new Marley Class 600 Double-Flow 5-cell cooling tower at the power station of the City of Burbank, California ... the newest thing in cooling tower design. Its job: to cool water to get more kilowatts from steam.

Wherever water cooling is vital to plant capacity, product quality or customer comfort, chances are you'll find a Marley Cooling Tower. You'll probably find Wagner® Motors there, too. They're on this tower in Burbank, driving the huge fans used in the tower's cells.

The job is a rugged one. It calls for motors that can operate without attention month after month ... motors that can stand constant exposure to all kinds of weather and to high humidity, the number one cause of motor failure in cooling tower applications.

Wagner Type EP Motors meet these requirements. All vital parts of these workhorse motors are totally enclosed, and are sealed against moisture by a series of grease retaining grooves between shaft and housing. Running shaft seals, at both ends of the frame, prevent the entrance of water into the bearing housings. The frames, endplates and conduit box are made of heavy cast iron for extra protection against high humidity and corrosion.

What about your requirements for motor drives that must operate under adverse conditions? Versatile Wagner Totally-Enclosed Motors can meet them, whatever the application. They are available in standard ratings through 500 hp. Call your nearby Wagner Sales Engineer for full details, or write for Bulletins MU-224 and MU-230.

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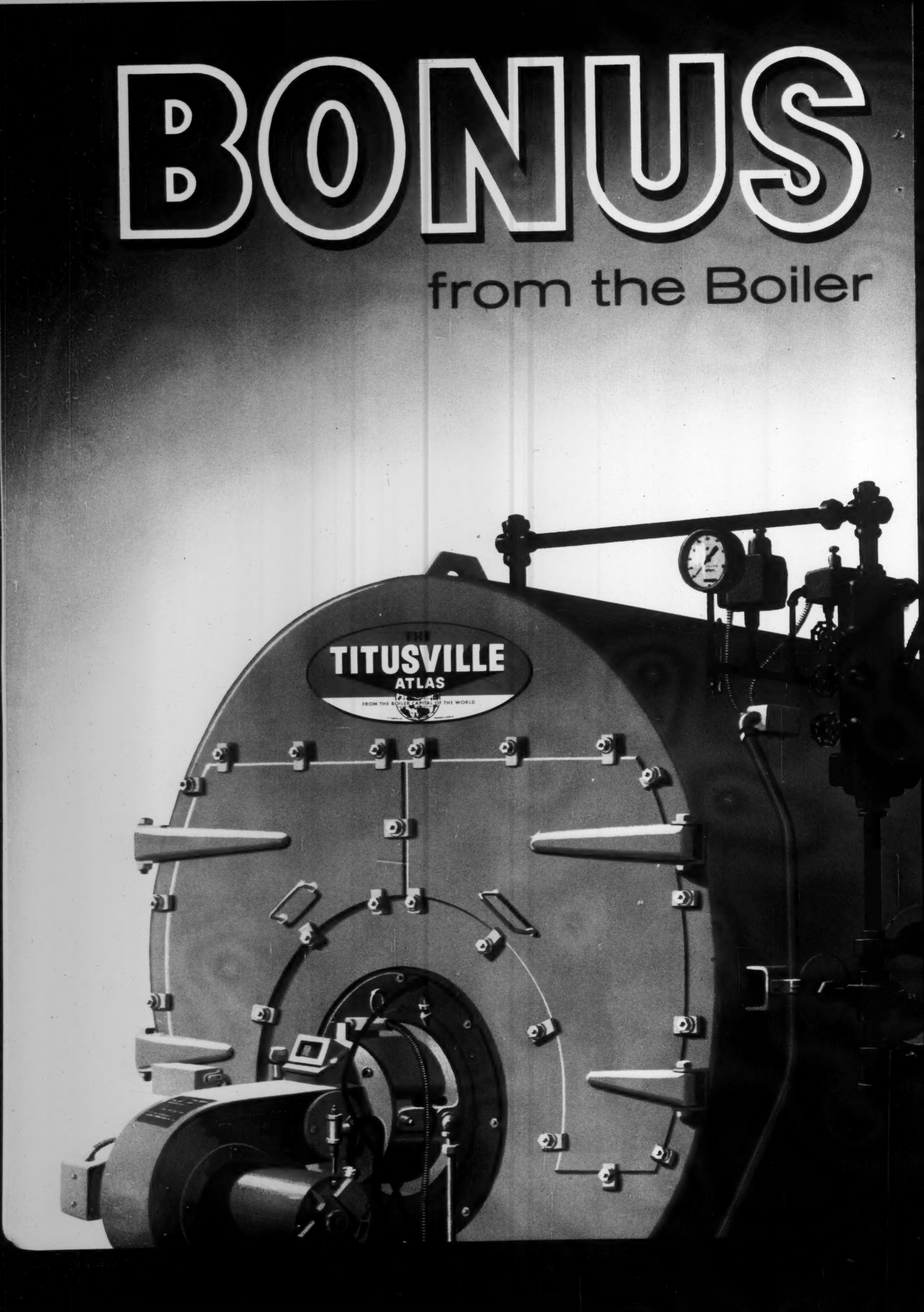

BONUS
from the Boiler
THE
TITUSVILLE
ATLAS
FROM THE BOILER CAPITAL OF THE WORLD
TITUSVILLE
PENNSYLVANIA

# POWER

## Capital of the World . . .

## THE TITUSVILLE-ATLAS

BONUS POWER means maintained high efficiency . . . longer life . . . less maintenance . . . more horsepower per total energy input. That's what you get when you install a complete TITUSVILLE-ATLAS unit, the only boiler with a patented wet back.

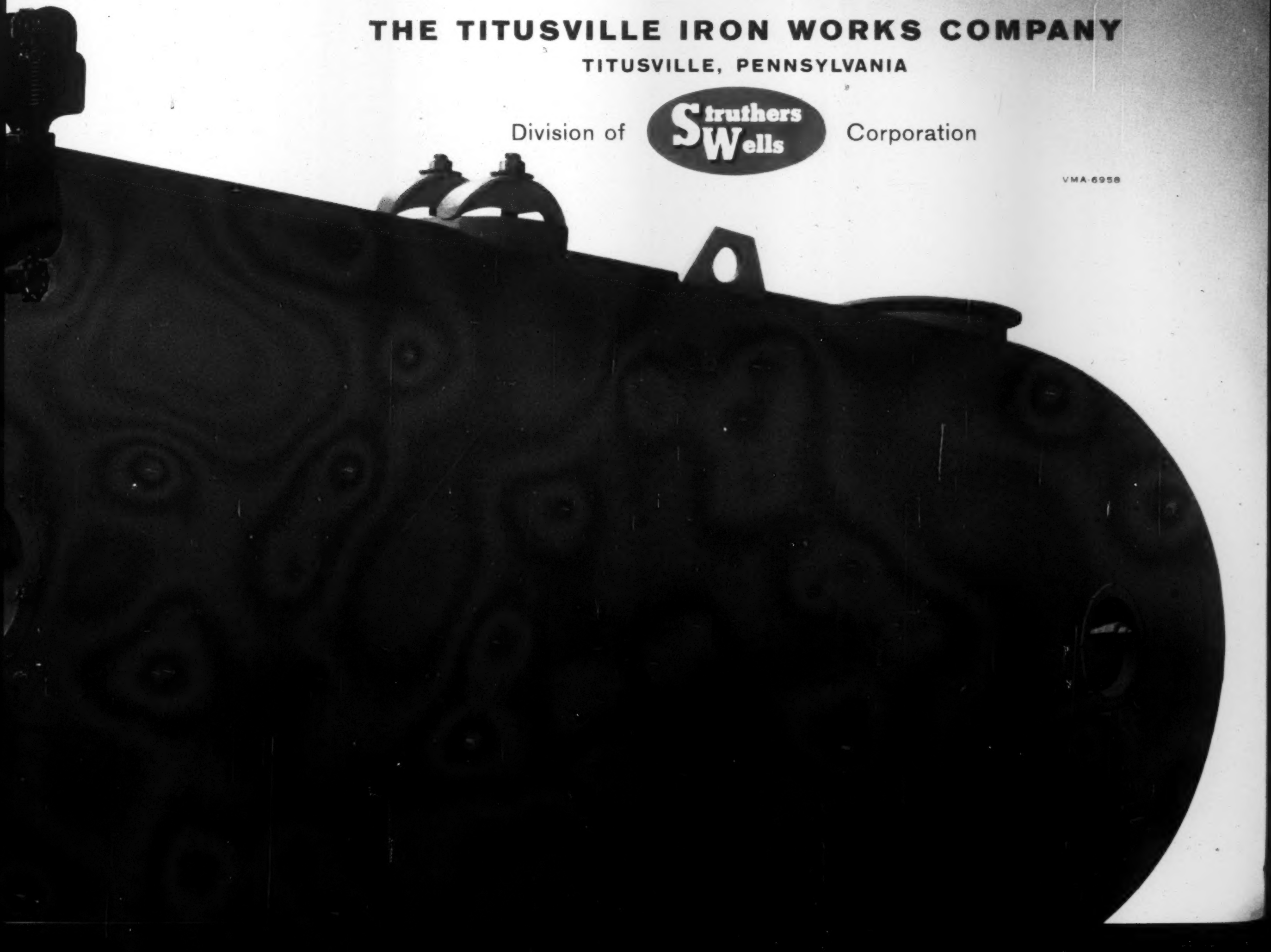
Wet-back design gives you maintained efficiency by eliminating back end refractories. *Result:* no down time for replacement.

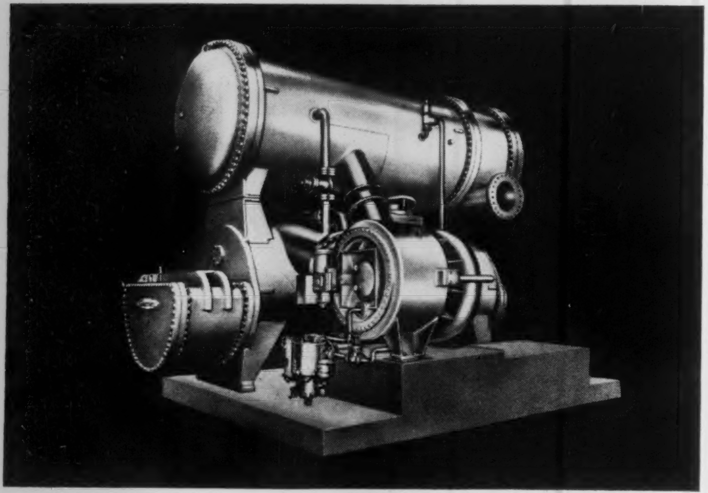
Larger furnace area permits reduced fan requirements. *Result:* lower operating costs. Get BONUS POWER. Specify TITUSVILLE-ATLAS.

**THE TITUSVILLE IRON WORKS COMPANY**
TITUSVILLE, PENNSYLVANIA

Division of Struthers Wells Corporation

VMA-6958





Meets today's trend
toward bigger installations
of air conditioning
and process cooling

## First with 5000-ton Capacity...
## Carrier Centrifugal Refrigeration!

Since it developed the first Centrifugal Refrigerating Machine in 1923, Carrier has made many major improvements that have brought centrifugal refrigeration to its present high degree of acceptance. Now Carrier is first again with a machine of 5000-ton capacity, designed to effect economies in the biggest air conditioning and process cooling jobs.

Today there are more than 5000 Carrier Centrifugals in use, a record unparalleled in the industry. You can recommend them to your clients with an assurance of reliability and efficiency based on years of successful experience. Available in capacities from 100 tons, they can be powered with any make or type of electric motor—or with a high or low pressure steam turbine, or a gas, gasoline or diesel engine.

Carrier offers a complete line of components to match the requirements of any air conditioning or refrigeration problem. For information, write Carrier Air Conditioning Company, Syracuse 1, New York. In Canada: Carrier Air Conditioning Ltd., Toronto.

**Carrier Air Conditioning Company**
A DIVISION OF CARRIER CORPORATION

# you'll want to know . . .

## Air Filter Institute Adopts Dust Spot Test Code

A NEW test code has been prepared and adopted by the Air Filter Institute to supplement the existing AFI Code Section 1. Together, the two codes specify methods of testing applicable to all ventilation and air conditioning air filters having an atmospheric dust spot efficiency of 98 percent or less.

The new code describes a discoloration or "dust spot" procedure using atmospheric air as a source of contaminant. Pertinent parts of AFI's summary of the Dust Spot Test Code follow:

"1. Name. AFI Dust Spot Test Code.

"2. Application. The procedure is applicable primarily to those air cleaners having the ability to remove an appreciable portion of atmospheric particulate responsible for discoloration and staining. Examples are electronic air cleaners and high efficiency dry type filter units. Generally, it is believed the procedure will be used most widely for filters having AFI Dust Spot efficiencies from 50 to 98 percent.

"3. Source of Contaminant. No artificial dust is used. Spot or stain is developed by drawing atmospheric air through Whatman No. 41 filter papers.

"4. Samplers. Samples are taken upstream and downstream from test device; sampler is located in test duct; sampler air flow is established by critical flow nozzle in sampler.

"5. Target Evaluation. Opacity of stain is established on basis of reduction in light transmission as measured by photometer.

"6. Photometer. Photometer is essentially the unit developed by University of Minnesota investigators. Unit is described in ASHAE Transactions, pp. 171-186, Vol. 63, 1957.

"7. Test Duct. Specified duct is 24 × 24 in. in cross section, 6 ft from entrance to device under

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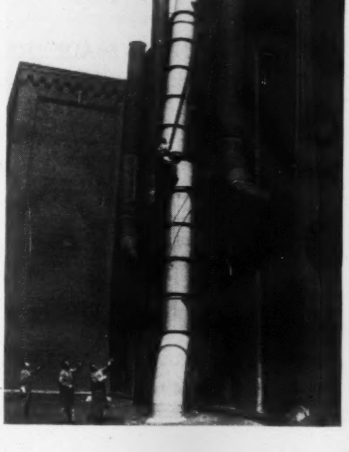
## Install Tallest Plastic Exhaust Stack



RIGID VINYL has been used to fabricate an 80 ft high exhaust stack in what may be the largest installation of this type ever made, according to B. F. Goodrich Co.

The stack is used to exhaust corrosive fumes from an automatic plater at the company's Akron, Ohio, works. Chamberlin Rubber Co., of Rochester, N.Y., fabricated the stack by forming a series of 36 in. diameter spool-like sections from $1/8$ in. thick material. Life expectancy for the installation is reported to be 15 years.

**you'll want to know**

test, 11 ft from air leaving side of device to flow nozzle, and 4 ft from flow nozzle to air mover.

"8. Test Results. Code fully specifies manner in which results are presented for official rating purposes."

The new code uses the same principle, in essence, as the N.B.S. Method, atmospheric air, described by R. S. Dill in ASHVE Transactions, Vol. 44, 1938. The AFI method, however, specifies all critical elements in the equipment and procedure, including duct length, sampling positions, static tap locations, sampler construction, photometer construction, air flow measurement technique, and reporting format. Samplers are also different from those used in the Dill method.

It is expected that filters having efficiencies of less than 50 percent will be tested and rated by the gravimetric system described in Section 1 of the existing code, but in some cases it may be necessary to give ratings by both methods.

## Air Conditioned Equipment To Track Astronauts In Orbit

TRACKING STATIONS strung out around the globe to monitor the course of the first astronaut in space will depend upon air conditioning to provide the precise environment needed to operate the complex electronic equipment, according to Westinghouse Electric Corp.

Various stations along the chain will be linked with point-to-point communications systems, while others will be equipped to talk directly with the astronaut over ground-to-air equipment. Telemetering systems used to monitor the operating equipment within the space capsule will send hundreds of messages to the network headquarters post in Greenbelt, Md.

Because the success of the project and safety of the first man in space will depend in large part upon communication equipment operating at peak efficiency, the tracking centers will be air conditioned to insure a specified and stable atmosphere.

Present plans are to launch the man-carrying satellite into orbit 100 miles above the earth from Cape Canaveral some time in 1961. The capsule will circle the globe three times, each trip requiring approximately 90 minutes. The path of the satellite will bring it within range of tracking stations in Africa and Australia, and in the Atlantic, Pacific, and Indian oceans.

Air conditioning systems designed for the various stations must meet the demands of the different climatic conditions. Central systems with separate water chillers and air handling units will be used to condition the larger buildings housing tracking and transmission equipment. The systems will range in capacity from 20 to 40 tons. Packaged air conditioning units will be used to condition the auxiliary buildings at each station.

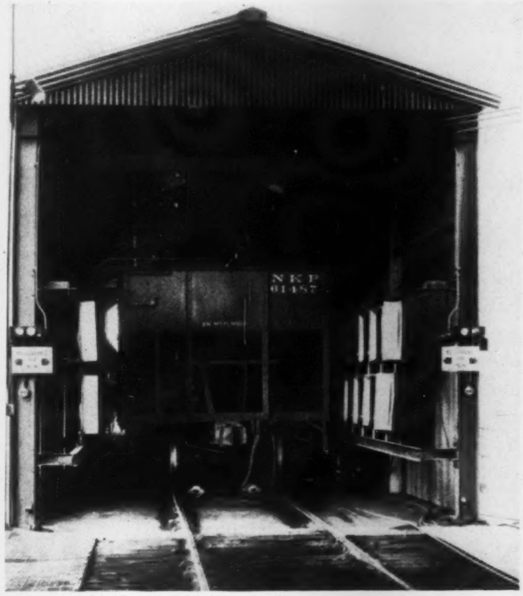
Shipment of the necessary equipment to some tracking sites has already begun.

---

# Man-sized Air Duct

**THIS IS AN INTAKE AIR DUCT measuring 9 ft by 5 ft and fabricated of galvanized steel sheet which will provide outside air to the ventilation system for Chicago's new $35 million Exposition Center. The Center will incorporate all facilities for conventions, trade shows, fairs and exhibits and other events, plus a 5000 seat theater and two restaurants capable of serving 1800 people per hr, under one 9-1/3 acre roof. Two and one half million lb of galvanized sheets will be required for the ventilation system, being installed under joint contract by The Zack Co., and The Anderson & Litwack Co., both Chicago area sheet metal and air conditioning contractors.**

# Infrared Thaws Hopper Cars, Saves Time And Expense



RAILROAD hopper cars used to deliver coal and other bulk materials to the United States Steel Corp's. Youngstown, Ohio sintering plant No. 2 are now freed of their ice-bound loads faster and at less expense by means of gas fired infrared thawing equipment, according to Hauck Mfg. Co.

Radiant heating panels are mounted within the oven enclosure so as to reach top, sides, and under panels of each car. The highest capacity units are installed between the rails to direct about 4 million Btu per hr at the hopper's pockets and slope sheets. Side panels deliver up to 2 million Btu per hr, while the overhead heaters loosen the top crust of frozen material with a capacity of 300,000 Btu per hr.

Labor costs are saved since one man can perform the whole operation. Further savings are reported due to the shorter thawing time required, since the steel company is liable for "demurrage" or charges levied as a result of cars being kept beyond an allotted time period. Damage to cars as a result of thawing operations has also been reduced.

---

## Air Conditioning Aids Behavior Studies

AIR CONDITIONING will eliminate one of the variables in child behavior studies at the new $1 million Program building at Merrill-Palmer Institute in Detroit, according to Carrier Corp.

The new building houses class rooms, faculty and administrative offices, nursery school facilities, observation booths, play therapy rooms, and other specialized areas.

About 100 college students each year attend the institute to study all phases of human behavior. Professional and other groups are also provided with educational opportunities in this and allied fields.

Institute developments director David J. Williams expects that the new controlled environment will aid materially in long-term studies by eliminating the variable of changing attitudes and moods occasioned by changes in weather and comfort conditions. Consistent conditions will allow more accurate recording of the behavior patterns studied.

Other reasons given for the decision to air condition were greater use of available space, the prospect of frequent meetings involving larger groups, and easier maintenance of interior surfaces and furnishings.

The building will employ an absorption cooling system using district steam.

## Radioactive Gas Traces Air Pollution

RADON, a naturally occurring radioactive gas that appears always in the earth's soil, has been used as a "tracer" in a study of the effect of weather conditions on air pollution at Argonne National Laboratory.

Each square mile of the earth's crust, to a depth of 6 in., contains approximately one gram of radon. The gas is a product of radioactive disintegration of radium atoms in the soil. The radium disintegration process releases tiny amounts of radon through the soil into the atmosphere, which contains on the average one part of radon to one billion billion parts of air.

By measuring atmospheric concentrations of radon each hour during three observation periods totalling 72 hours, scientists were able to observe how varying weather conditions affected the atmosphere's ability to cleanse itself of pollution. The tests, which were conducted from ground level to an altitude of 130 ft, resulted in the following observations, according to Harry Moses, head of the laboratory meteorology group:

Dilution of contamination is very slow on clear nights when only light winds are present, due to the lack of vertical mixing between air currents. On sunny days, with higher velocity winds, contamination dilution is rapid. Convection currents immediately after sunrise carried radon concentrations to higher altitudes because of ground heating. According to the laboratory, this is the reversal of the usual process, in which pollutants descend to the earth from the upper layers of the atmosphere at this time. Two to three times more radon was dis-

## you'll want to know

covered at a height of two or three stories at night.

Weather conditions were found to cause fluctuations of more than 100 percent in a single hour in the horizontal distribution of gas.

Techniques employed in the study included the use of powdered charcoal filters connected to intake tubes mounted atop a 130 ft weather tower. Air entering the tubes was measured, dehydrated and filtered to collect the radon. Processing of the filters allowed scientists to measure the radioactive content, which was related to the volume of air sampled. Thirty different meteorological variables were considered in the experiment.

### Plan Student Introduction To Air Conditioning Field

APPROXIMATELY forty California high school juniors and seniors with outstanding academic records will be invited to attend a two day air conditioning and refrigeration institute at California State Polytechnic College's San Luis Obispo campus during December of this year, in what is reported to be the first major institute of this type in the nation.

The program will be financed by a $2000 grant from the Western Air Conditioning Industries Association, and will include panels and speakers from practicing and teaching areas of the industry, who will describe various phases of careers within or allied to the field.

Cal Poly offers an air conditioning and refrigeration curriculum as one of nine major engineering programs at the San Luis Obispo campus. Harold P. Hayes, dean of the college, notes that there are "numerous young men who have never so much as considered this field of engineering," and that the institute will be a step toward informing "not only the students themselves, but the people back home, since one of our most frequent type of engineering opportunities offered to graduates is that of air conditioning engineering."

William P. Tennity, president of WACIA, stated that the institute would follow a broad professional approach to emphasize the scientific, sociological, mathematical, and personal, as well as the mechanical requirements and opportunities in the industry.

Selection of the participating students will be effected by a committee of college faculty members.

## *Chicago's Loop Gets First "Doorless Doors"*

THE recently remodeled Bell Savings and Loan Association Savings Center in Chicago's downtown area now boasts the first two air curtain entrances installed in the "Loop."

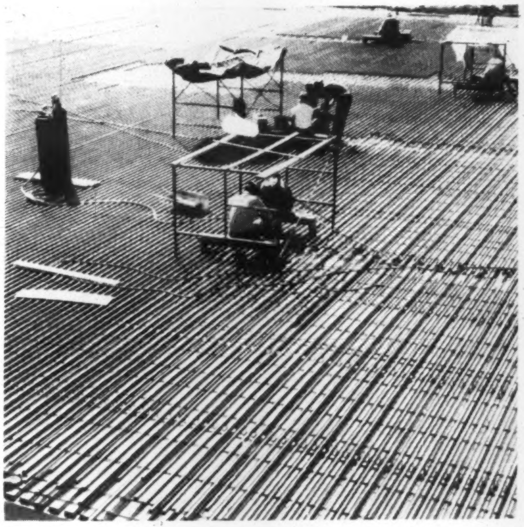
The main entrance to the Center, at the corner of Monroe and Clark streets, is 15 ft wide and during business hours is entirely open to traffic except for a narrow center framing structure. A 7 ft wide side entrance is also equipped with the air curtain feature.

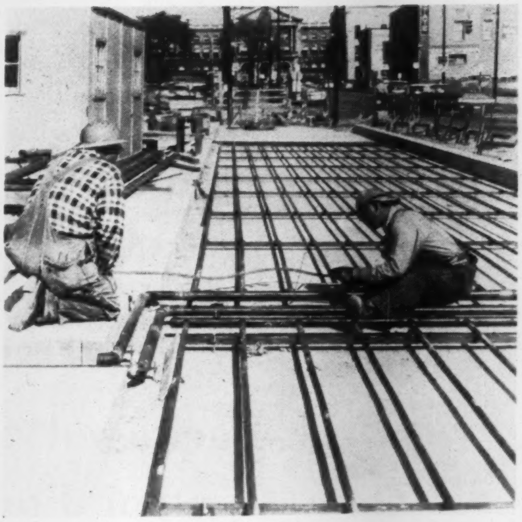
The systems are made up of blowers installed above the openings which direct air downward through an overhead grating to provide a gentle vertical curtain across the entire entrance. After passing through a floor grating, the air is conditioned as needed — filtered, washed, cooled in summer and heated in winter, after which a basement blower returns it via vertical side plenums to the top of the entrance.

The systems are controlled by outside sensing units to compensate for varying temperatures and wind velocities. While the air curtain is sufficient to exclude drafts and invading insects, persons passing through the doorway hardly notice it.

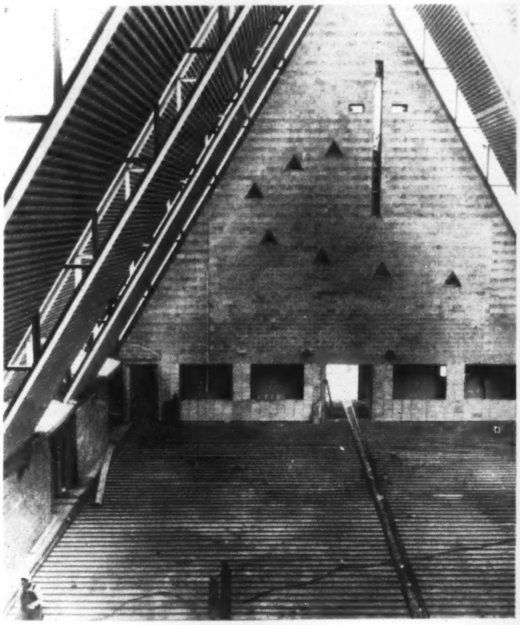
Conventional glass panel doors which fold away to the side are provided for after-hours security.

For additional articles on the design and operation of air curtain entrances, see HPAC January 1956, p. 146; March 1956, p. 97; August 1957, p. 112; and October 1957, p. 124.





# Pipe Grids Used For Heating, Freezing, Snow Melting



PIPING GRIDS embedded in concrete or other materials perform a variety of functions, including those pictured here, as reported by A. M. Byers Co.

The photo at lower left shows the interior of the new St. Sebastian Church near Pittsburgh, which has been equipped with an 11,000 sq ft radiant heating grid of 1 in. pipe, spaced on 16 in. centers and buried in 4 in. of concrete. Circulating hot water at 140 F maximum temperature will yield 640,000 Btu per hr heating capacity, to provide about 70 percent of the building's heating requirements. The system is supplemented by a warm air heating plant.

At upper left, 1-¼ in. brine lines are being installed for a 120 × 208 ft ice rink near Pittsburgh. Headers up to 10 in. in diameter are used at the rink, which requires 280 tons of chilled brine capacity. Welded joints are used throughout the system.

At the upper right, a thermostatically controlled snow melting system is pictured during construction at the new Libbey-Owens-Ford Glass Co.'s building in Toledo, Ohio. Three sidewalks and a 60 × 85 ft entrance way outside the building are thus equipped.

---

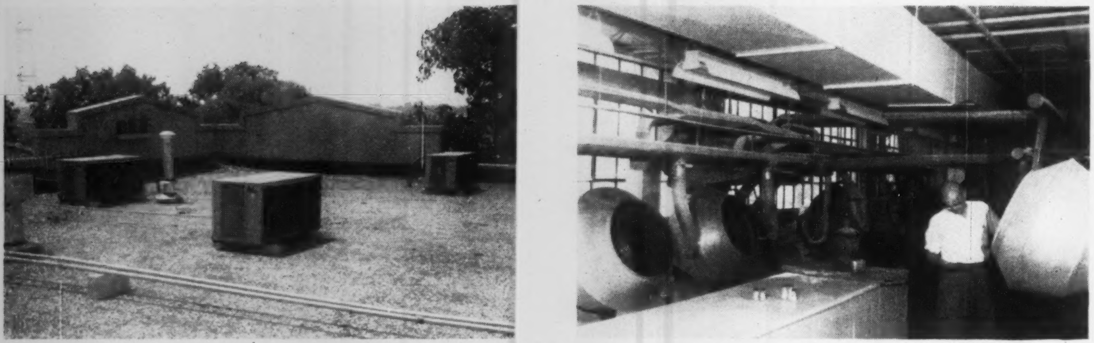
## Plastic Pipe Standard Revision Announced

A RECOMMENDED revision of Commercial Standard CS197-59, reflecting improvements in flexible polyethylene plastic pipe, has been submitted to the industry for consideration and acceptance.

The revision was prepared by the Commodity Standards Div., Office of Technical Services, of the U. S. Department of Commerce Business and Defense Services Administration, in cooperation with the Society of the Plastics Industry, Inc.

The recommended change covers requirements for material, workmanship, dimensions, working pressure, field pressure, incremental pressure, sustained pressure and environmental cracking for three types of resin, one schedule, and two series of polyethylene pipe. Marking methods as indication of compliance with the standard are also included.

Copies of the revision, which is designated TS-5496, are available upon request from H. A. Bonnet, Commodity Standards Div., U. S. Dept. of Commerce, Washington 25, D.C.



EACH OF THESE air cooled condensing units serves a single coated tablet processing area like the one above, in Ohio plant

# Packaged Units Provide Zone Control For Ohio Pill Factory

Capsules and tablets for national distribution to medical and allied fields can now be manufactured year 'round at the Warren-Teed Products Company's Columbus, Ohio, plant, according to the Armstrong Furnace Co.

The manufacturer of ethical pharmaceutical products previously had been forced to schedule production operations for the manufacture of coated tablets during cooler periods of the year, when outside temperature and humidity would not interfere.

Some cooling had been achieved within the plant by means of individual window-type air conditioners, but zone control of the environment for different processing areas was needed.

A total of 63 tons of cooling capacity has been provided for the three-story building with the installation of a number of 3 and 5 ton packaged evaporator-blower units. Each unit is located within the particular zone to be cooled, and conditioned air is distributed throughout the area by means of ducts. Roof mounted air cooled condensing units are installed, each of which serves a single evaporator section.

By this means, individual zone control for the various processing areas is achieved, and in addition, any maintenance which may be required in the future will affect no operation other than the one in the zone involved. Additional cooling capacity can be provided for future expansion by installing more units.

Offices within the building are also air conditioned, but in these areas several rooms comprise a zone. Individual offices are equipped with damper controls so that occupants can regulate the cooling effect as they like.

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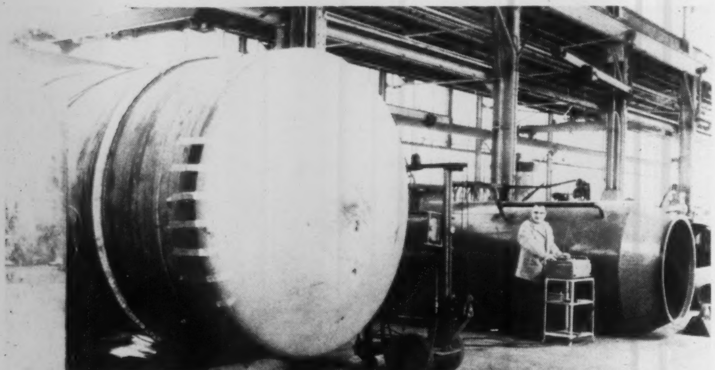
## *Mobile X-Ray Unit Cuts Weld Inspection Time*



Imaginative use of a 260 KV X-ray unit has enabled The Colonial Iron Works Co. of Cleveland to cut weld seam inspection time by as much as two-thirds, according to Westinghouse Electric Corp.

The Cleveland firm specializes in the design and fabrication of steel and corrosion-resistant equipment for process industries.

A smaller X-ray machine was replaced by the present unit three years ago. Up to that time, inspection was accomplished by means of an overhead crane, which carried the machine about the shop.

W. G. Singiser, chief welding inspector, designed a lightweight, rubber tired cart with a small hand

(*Continued on page 234*)

| PHYSICAL PROPERTIES | ARMAFLEX 22 | BRAND A | BRAND B | BRAND C | BRAND D |
|---|---|---|---|---|---|
| **LOW DENSITY**<br>(less than 7.5 lbs. per cu. ft.) | YES | NO | YES | YES | YES |
| **LOW WATER VAPOR TRANSMISSION**<br>(less than .15 Perm) | YES | NO | NO | YES | NO |
| **LOW WATER ABSORPTION**<br>(less than 3% by volume—28 days) | YES | NO | NO | YES | YES |
| **DIMENSIONALLY STABLE AT 200° F.**<br>(less than 5% lineal shrinkage—28 days) | YES | YES | YES | NO | NO |
| **DIMENSIONALLY STABLE AT 220° F.**<br>(less than 5% lineal shrinkage—28 days) | YES | NO | NO | NO | NO |
| **NEGLIGIBLE ODOR** | YES | NO | NO | (?) | NO |
| **SELF-EXTINGUISHING** | YES | YES | YES | (?) | YES |
| **OZONE RESISTANCE** | YES | YES | YES | YES | YES |
| **SMOOTH SURFACE** | YES | (?) | (?) | (?) | YES |

*Properties evaluated by tests at Armstrong Research and Development Center*
*(?) indicates results are inconclusive or classification a matter of individual judgment*

# What's better about the new Armstrong Armaflex 22?

This chart tells you at a glance why the improved Armaflex 22 gives superior performance on pipe covering work. New Armaflex 22 features a temperature range from below zero to 220° F.; a super-smooth exterior surface; and greater toughness and durability. For complete information on this fine quality flexible foamed plastic insulation, send for new booklet. Write to Armstrong Cork Company, 2204 Sherman Street, Lancaster, Pennsylvania.

Armstrong ARMAFLEX

**Armstrong INSULATIONS**

*1860-1960 Beginning our second century of progress*

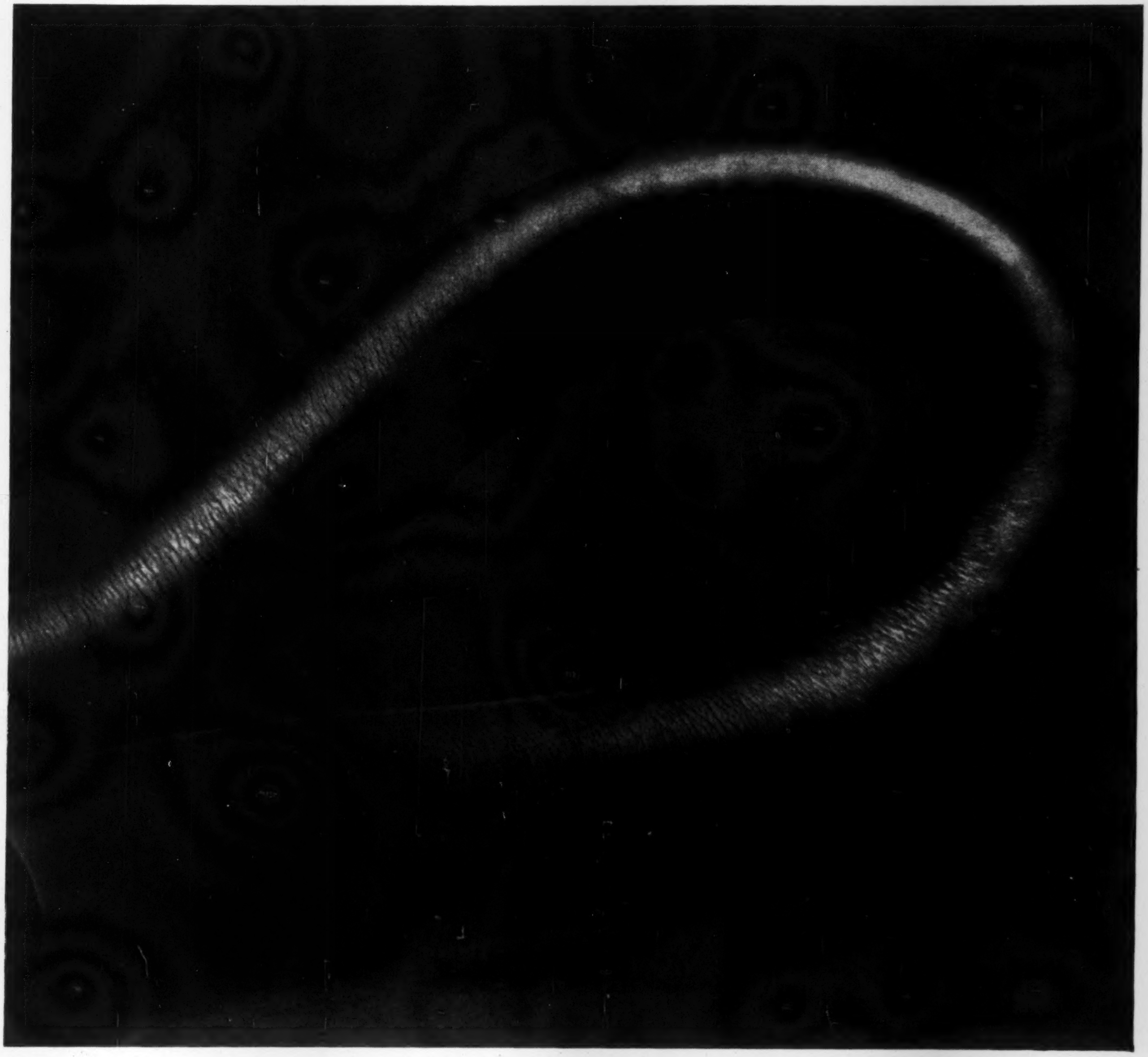
SWEAT-PROOF
INSULATION

# Stop pipe condensation with the built-in vapor barrier of J-M Aerotube

**...THE FLEXIBLE, FOAMED PLASTIC PIPE INSULATION THAT CUTS INSTALLATION COSTS IN HALF.**

For heating, plumbing and air-conditioning service—wherever sweating or condensation is a problem—Johns-Manville Aerotube® is the economical solution.

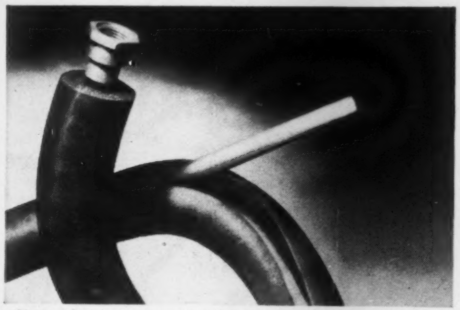
Aerotube is a tubular pipe insulation for use at temperatures from 32F to 220F (double layer of Aerotube permits range of 0F to 220F). Its closed cell structure stops the passage of moisture. This built-in vapor barrier, plus the insulating effectiveness of Aerotube, will prevent condensation under normal design conditions on indoor lines. What's more, you



can depend upon Aerotube to maintain its effectiveness indefinitely.

Aerotube is the easiest-to-install pipe insulation available today. On a straight run of pipe or the most complex bend, Aerotube's six-foot lengths go on quickly. For connected pipe, just slit Aerotube longitudinally, snap it on, and seal it up! You'll discover that labor costs are substantially reduced when Aerotube is chosen to solve condensation problems.

Available in a wide range of thicknesses, there's an Aerotube insulation that meets your particular needs. For full information, send for brochure IN-213A. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.



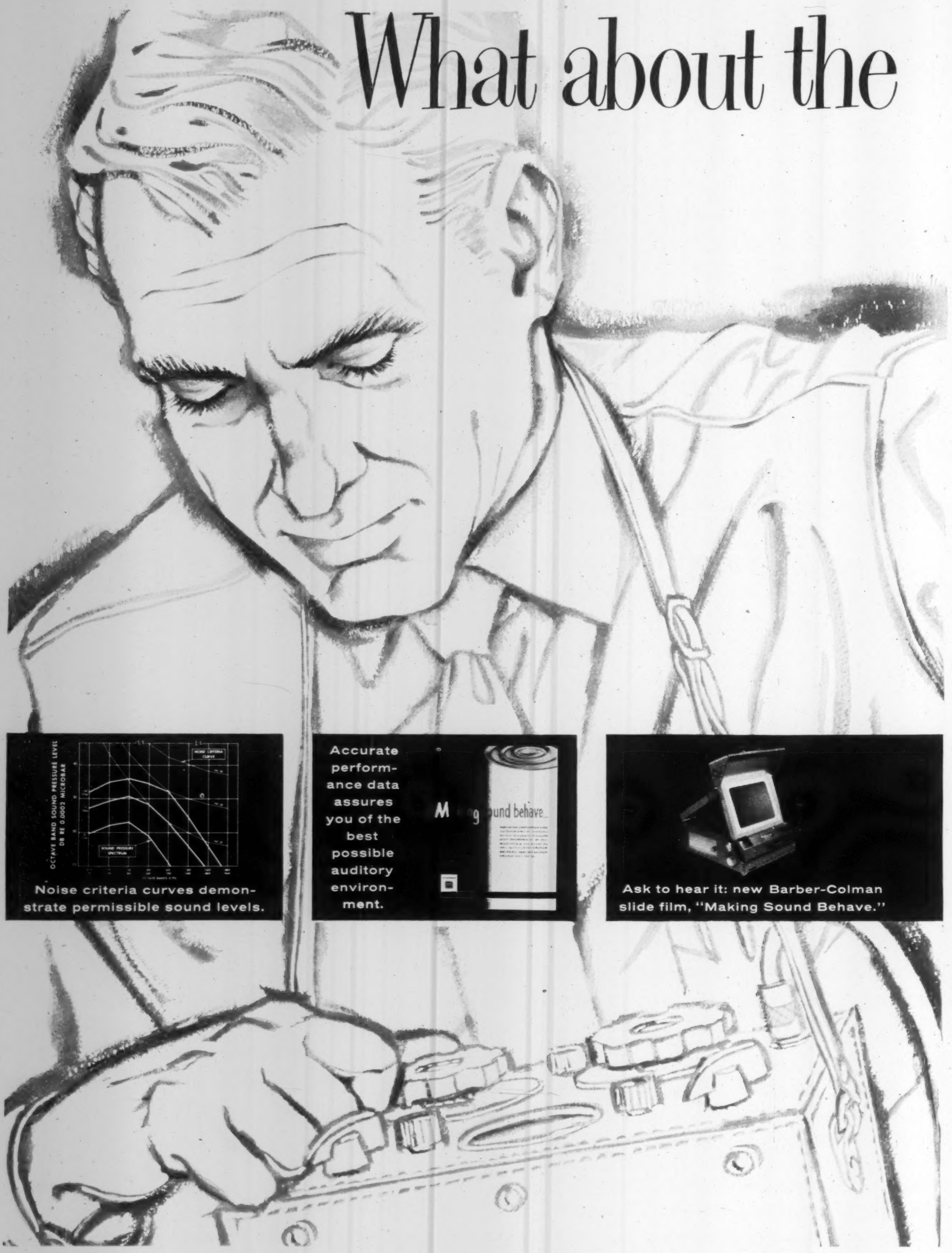
Even the most complex bend is easy to insulate with flexible J-M Aerotube.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

AN INSULATION FOR EVERY COMMERCIAL AND INDUSTRIAL USE

# What about the


OCTAVE BAND SOUND PRESSURE LEVEL
DB RE 0.0002 MICROBAR
NOISE CRITERIA CURVE
SOUND PRESSURE SPECTRUM
OCTAVE BANDS IN CPS
Making Sound behave...

Noise criteria curves demonstrate permissible sound levels.

Accurate performance data assures you of the best possible auditory environment.

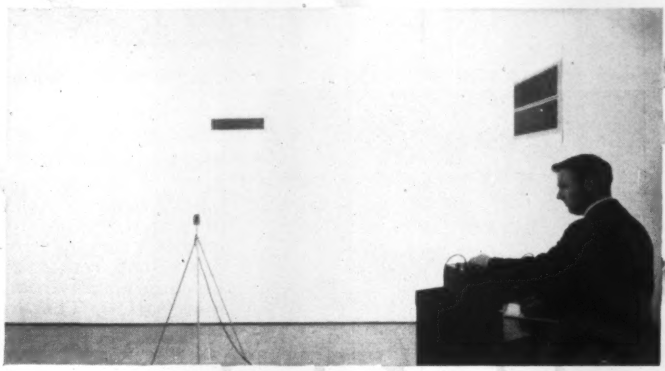
Ask to hear it: new Barber-Colman slide film, "Making Sound Behave."

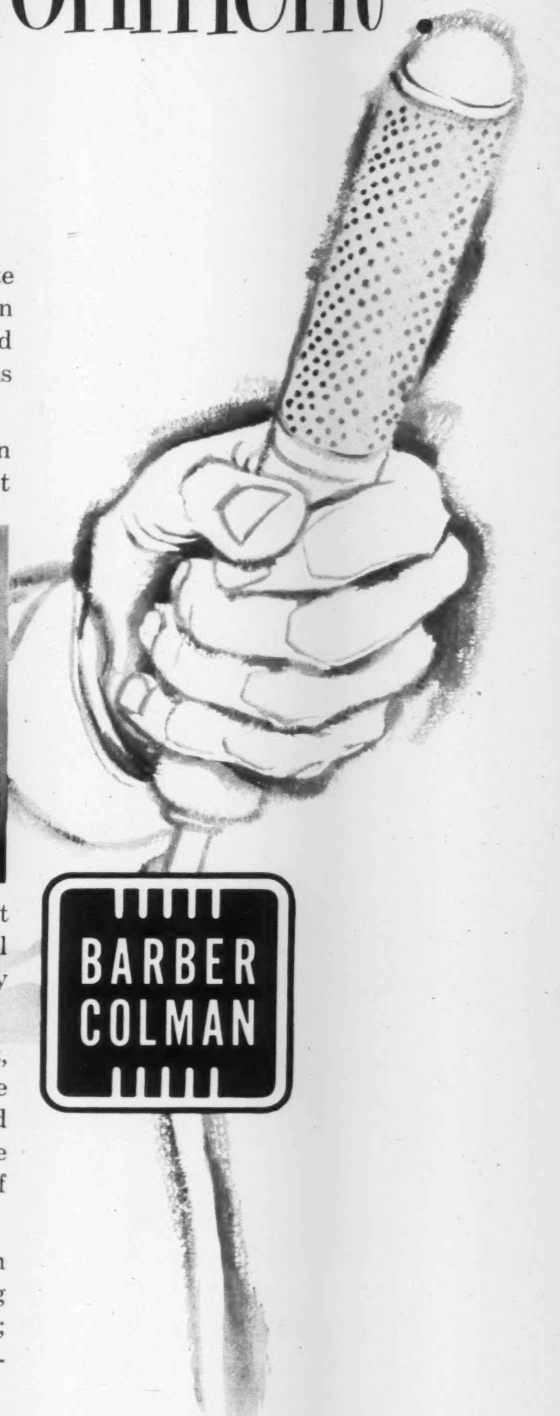
# auditory environment?

## Facts about air distribution sound levels of importance to engineers and architects

An architect skillfully uses both color and light to create the proper environment. A good analogy exists between an architect working with frequencies of light (color) and an engineer creating ideal air distribution specifications with sound.

Until recently engineers used only the decibel level in selecting air distribution equipment. Today this is not enough to assure comfortable environment, for sound must be measured and specified not only in terms of over-all magnitude, but also in magnitude at different frequency levels.





BARBER
COLMAN

To help you create the proper auditory environment, Barber-Colman has built modern sound laboratories where engineers break down into eight octave bands the sound of air passing through Uni-Flo diffusers. The decibel value of each band then is charted for a complete range of capacities.

The results are twofold: data is available for comparison with noise criteria curves which are used for specifying permissible sound levels in different frequency bands; scientifically proved performance data is provided for correct selection of air distribution equipment.

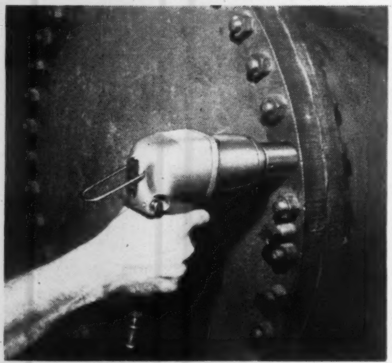
Ask for literature and be sure to see — and hear — Barber-Colman's new slide film, "Making Sound Behave."

**BARBER-COLMAN COMPANY**
Dept. I, 1101 Rock Street, Rockford, Illinois

# SIOUX *impact* offer Torque

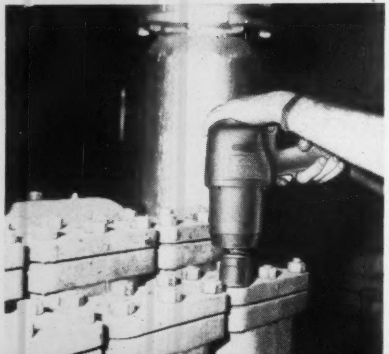
## SIOUX *Electric* IMPACT WRENCHES

Sioux electric impact wrenches offer equal power in right or left hand rotation. The torque for each wrench is stated and certified. Their mechanical design offers exactly the same advantages as that of the air wrenches. Their exclusive reverse cap switch lock prevents reversing with the current on, and eliminates burning commutator brushes and switch contacts. They are unexcelled in performance.



The Sioux No. 318, 5/8" drive, is shown removing 5/8" bolts on the head of a steam condenser, part of a turbine driven, centrifugal refrigeration machine air conditioning installation. This head has to be removed once a year for cleaning the tubes.

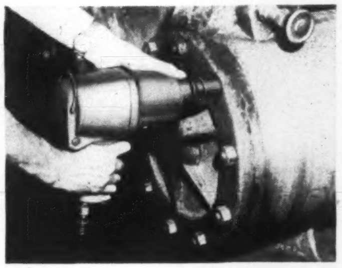
Here the Sioux No. 322, 1" drive, is removing 7/8" bolts from the head of a heat exchanger, part of an air conditioning installation which uses river water. Tubes must be cleaned monthly in the summer time in order to keep the heat transfer at efficient levels, particularly as the river water is dirty.



The Sioux No. 322 here is removing 3/4" bolts on the water end of a boiler feed pump. This is a yearly maintenance operation for reseating valves, etc.

# wrenches

# for every task!



This photo was taken in a boiler room and shows the Sioux No. 322 removing ¾″ bolts from the steam end of a boiler feed pump. This must be done yearly for pulling pistons for maintenance.

CERTIFIED SIOUX POWER

**SIOUX** tells you the torque your air or electric impact wrench will deliver. (See specifications.) You don't buy just a wrench. You buy certified Sioux power! Reversible power. And on air wrenches controllable power through eight point power selector.

### PROVEN EFFICIENCY

Here, the advantage of the exclusive Sioux mechanical design is revealed! You can expect your Sioux air impact wrench to deliver *15% more torque* while *consuming 30% less air!* Less power is absorbed by the wrench itself. More is applied to the drive!

### FIELD TESTED, TIME TESTED PROVEN DEPENDABILITY

The exclusive Sioux impact wrench mechanical design has passed the toughest test of all . . . the test of time. Thousands have been giving dependable, trouble-free service for years.

### REACTION BALANCED for Less Vibration Feedback

All Sioux Impact Wrenches are "reaction balanced" for less vibration and torque feedback and for minimum operator fatigue. You can feel the difference!

**ANGLE ATTACHMENT**—used directly on the square of the impact wrench to reach those hard to get at spots.

## Compare the TORQUE! the QUALITY!

| Cat. No. | AIR<br>Square Drive | Cap. Bolt Size | Torque Ft. lbs. at 90 lbs. Air Pressure at Tool |
|---|---|---|---|
| 313 | 3/8″ | 3/8″ | 60 |
| 314 | 1/2″ | 7/16″ | 75 |
| 303* | 1/4″ Hex | | |
| 315 | 1/2″ | 5/8″ | 130 |
| 312* | 7/16″ Hex | | |
| 316 | 1/2″ | 5/8″ | 195 |
| 317 | 5/8″ | 5/8″ | 195 |
| 318 | 5/8″ | 3/4″ | 250 |
| 319 | 5/8″ | 7/8″ | 425 |
| 320 | 3/4″ | 1″ | 750 |
| 322 | 1″ | 1 1/8″ | 1000 |

*AIR SCREWDRIVER

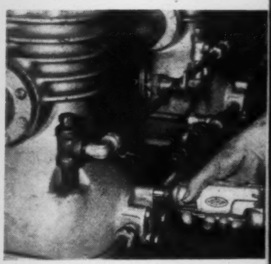
| Cat. No. | ELECTRIC<br>Square Drive | Cap. Bolt Size | Torque Ft. lbs. in 10 sec. operation Right or Left |
|---|---|---|---|
| 323 | 3/8″ | 7/16″ | 75 |
| 333 | 1/2″ | 7/16″ | 75 |
| 325 | 1/2″ | 5/8″ | 125 |
| 330 | 1/2″ | 5/8″ | 175 |
| 335 | 5/8″ | 5/8″ | 175 |

ALSO NO'S. 260, 262, 242, 246 ELECTRIC SCREWDRIVERS

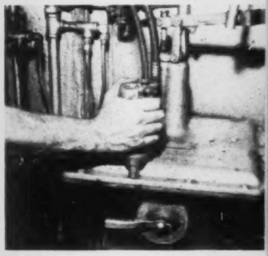
**ALBERTSON & CO., INC.** SIOUX CITY
IOWA, U.S.A.

### NO. 313, 314 SIOUX AIR IMPACT WRENCHES

These models feature an exclusive, remote air exhaust that carries exhausting air, and oil 6 feet from the operator, for quieter, cleaner operation. They're designed for use in restricted space, where necessary.



The Sioux No. 313 with ⅝″ wrench, ⅜″ drive is being used on a boiler control to replace a diaphragm and make other repair. As these boilers furnish steam for driving turbines, that drive refrigeration machines in summer and steam for heating in winter repairs have to be made quickly.

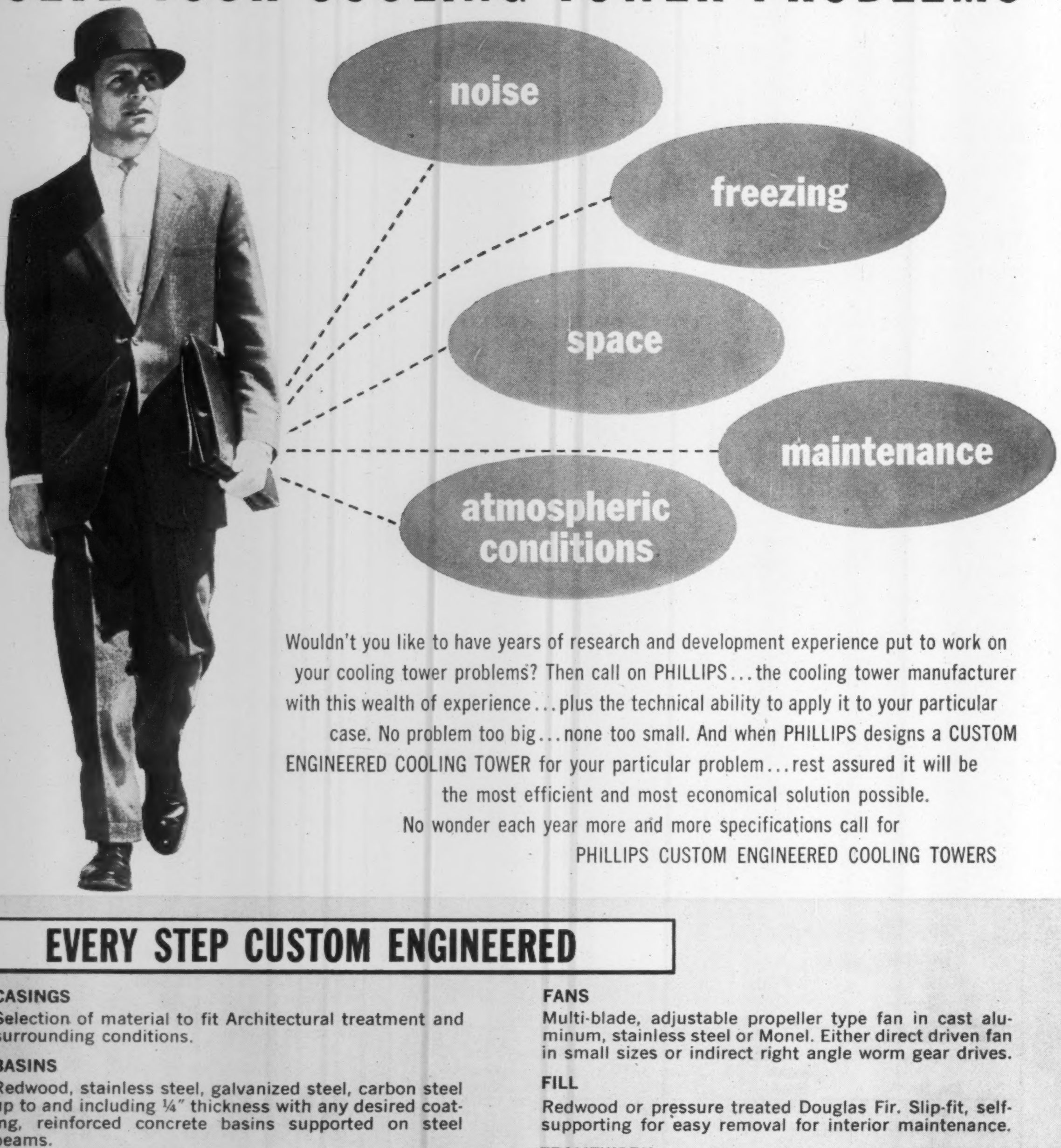


## SIOUX's the BUY!

AIR IMPACT WRENCHES • AIR SCREWDRIVERS • DRILLS • "PELICAN" NUT ACCUMULATORS • FLEXIBLE SHAFTS • ELECTRIC IMPACT WRENCHES • GRINDERS • SANDERS • POLISHERS • SCREWDRIVERS • PORTABLE SAWS • VALVE FACE GRINDING MACHINES • ABRASIVE DISCS

# CALL ON *Phillips* CUSTOM ENGINEERING

# TO SOLVE YOUR COOLING TOWER PROBLEMS



Wouldn't you like to have years of research and development experience put to work on your cooling tower problems? Then call on PHILLIPS ... the cooling tower manufacturer with this wealth of experience ... plus the technical ability to apply it to your particular case. No problem too big ... none too small. And when PHILLIPS designs a CUSTOM ENGINEERED COOLING TOWER for your particular problem ... rest assured it will be the most efficient and most economical solution possible.

No wonder each year more and more specifications call for PHILLIPS CUSTOM ENGINEERED COOLING TOWERS

## EVERY STEP CUSTOM ENGINEERED

**CASINGS**

Selection of material to fit Architectural treatment and surrounding conditions.

**BASINS**

Redwood, stainless steel, galvanized steel, carbon steel up to and including ¼" thickness with any desired coating, reinforced concrete basins supported on steel beams.

**DISTRIBUTION SYSTEM**

Spray nozzle type or open Weir gravitational type system.

**FANS**

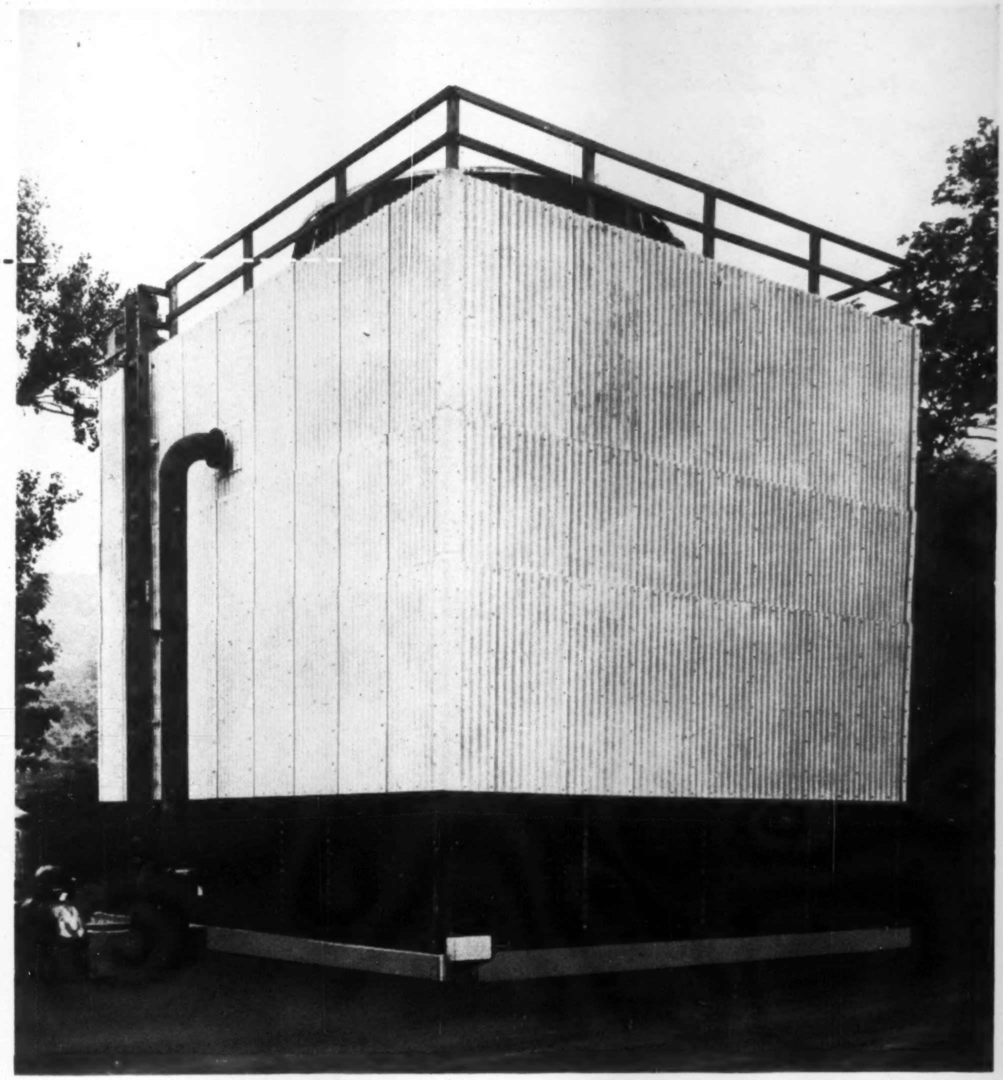
Multi-blade, adjustable propeller type fan in cast aluminum, stainless steel or Monel. Either direct driven fan in small sizes or indirect right angle worm gear drives.

**FILL**

Redwood or pressure treated Douglas Fir. Slip-fit, self-supporting for easy removal for interior maintenance.

**FRAMEWORK**

Hot dipped galvanized structural steel .250" minimum thickness. Redwood or pressure treated Douglas Fir.



UNION CARBIDE CO.
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**another problem solved by: Phillips**

**CUSTOM ENGINEERED COOLING TOWERS**

**THE PROBLEM:**
To get maximum cooling with a limited concrete basin area in order to save on construction costs.

**SOLUTION:**
**Phillips custom-engineered cooling tower** with framing dimensions specially designed to use the maximum area with a minimum of concrete.

**RESULT:**
A complete efficient cooling tower at economical cost.

SPECIAL FEATURES ON ALL TOWERS

Corrosion Resistant Hardware. Aluminum or Stainless Steel Fans. Nailless Redwood Filling Removable at Tower Base. Nailless Three-Pass Redwood Eliminators. Removable Louvers.

WRITE FOR
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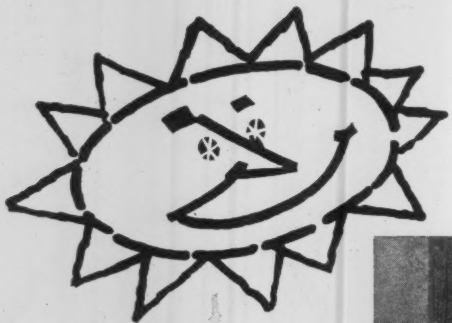
**Phillips**
**Cooling Tower Co., Inc.**
**220 DUPONT ST., BROOKLYN 22, N. Y.**



# another BRIGHT IDEA from ENGINEERS at PENN

## DAYLIGHT / VENTILATION IN *ONE* LOW ROOF EXHAUSTER

## the PENN LITEX

Two important benefits — natural light and moving air — have now been brought together in *one* wide area, low silhouette gravity roof exhauster, the Penn Litex! Ideal for any building where inexpensive daylighting is necessary, the Litex features a new engineering concept where light is emitted through translucent fiberglass weathercaps and dampers that operate manually or automatically.

The Litex is an expansion on the design of the standard Penn Linex gravity exhauster. Air currents are moved silently and efficiently. Modular units may be used in unlimited lengths to provide continous light and ventilation for warehouses, factories, gymnasiums, etc.

Complete information and performance data, including tables of illumination are provided in Bulletin LTX-59. Write for your copy today.

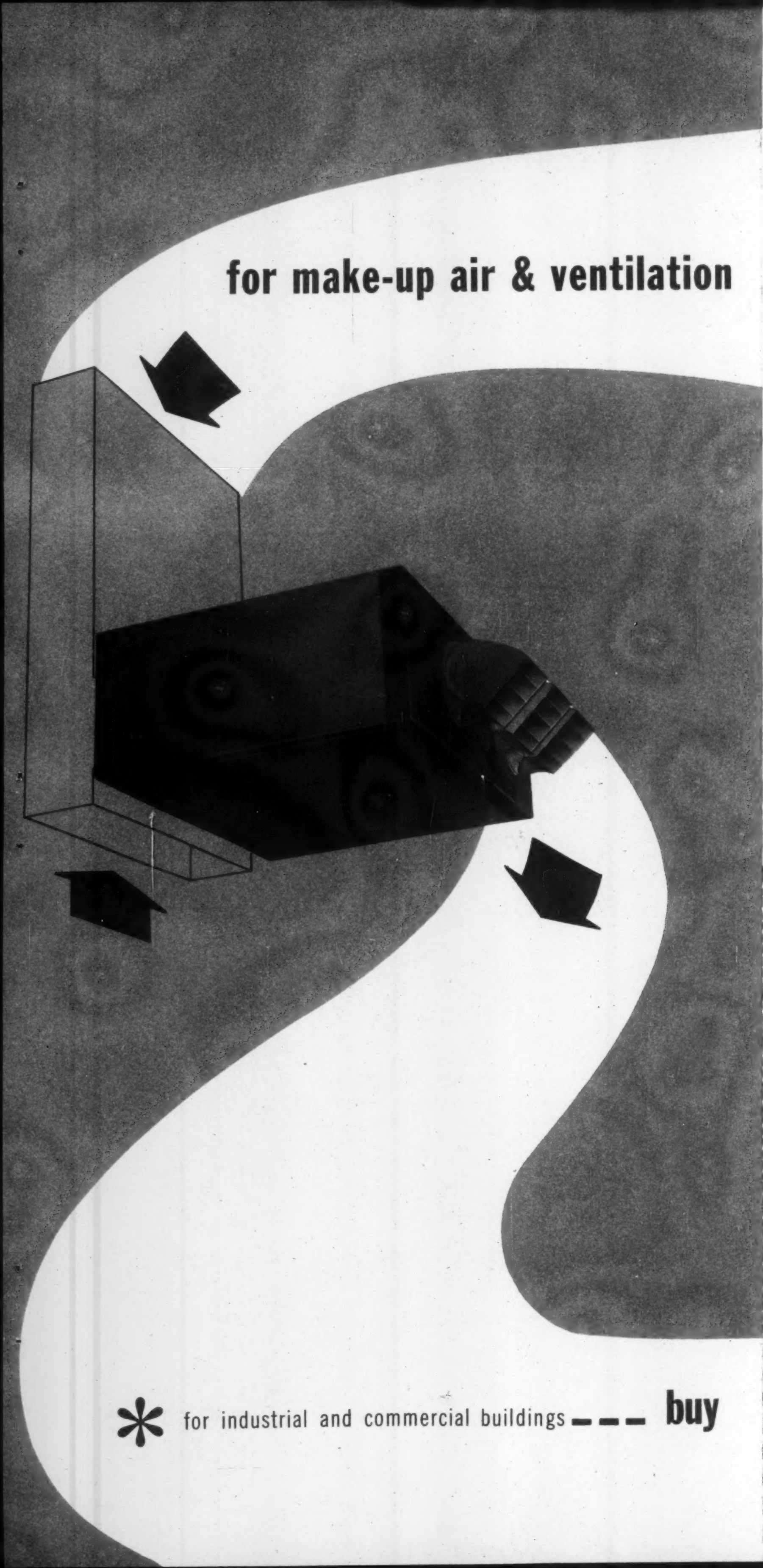
**PENN VENTILATOR CO., Inc.**
PHILADELPHIA 40, PENNA.

*A leading manufacturer of Powered and Gravity Roof Exhausters and Accessory Equipment for over 30 years.*

*Charter Member of AMCA*

Penn Ventilator products are available throughout the Free World.
One of many direct factory representatives at your service:

**R. J. Coughlin Co., Detroit, Mich.**


for make-up air & ventilation
* for industrial and commercial buildings --- buy

# Important Information Available!

Lennox Industries Inc., Dept. I-A34
Marshalltown, Iowa

Gentlemen:

I am interested in the items checked below. Please mail complete information to me on . . .

☐ Direct-fired industrial heaters
☐ Unit heaters
☐ Gas Duct heaters ☐ LENNOX APPLICATION MANUAL (Industrial direct-fired space heaters)
☐ Have a LENNOX representative call

Name__________
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No
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FIRST CLASS PERMIT NO. 53 MARSHALLTOWN, IOWA

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Will Be Paid
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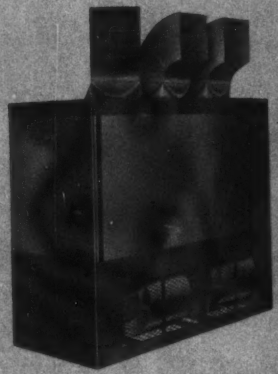
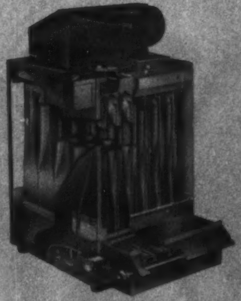
**LENNOX INDUSTRIES INC.**
**DEPT. I-A345**
**MARSHALLTOWN, IOWA**

### *Industrial unit heaters and central furnaces*



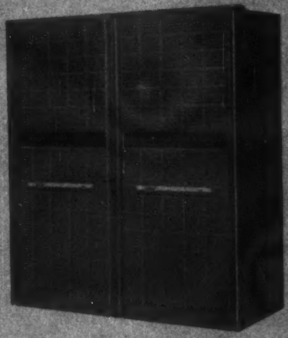
. . . the "big boy" of the Lennox line—the OG4 gas, oil or oil-gas industrial heater. It is available in up-flow, down-flo or horizontal models. It can be ordered with or without service platforms, blowers, dampers and filter boxes. The stainless and aluminized steel heat exchanger is designed for use with 100% outside air or an air conditioning unit placed up stream. Available in sizes from 280,000 to 2,000,000 Btuh input with on-off, hi-lo-off, or modulating burner control. The OG4 is especially engineered for make-up air and ventilation systems. This unit has air handling capacity of 16,000 CFM / 1,000,000 Btuh output.

### *Duct furnaces*



. . . combined with damper and blowers are excellent for make-up air systems. They have both up and down stream limit controls, and can pass air in either direction. The aluminized steel heat exchanger is not affected by direct exposure to outside air. The GSDI is available from 120,000 to 420,000 Btuh input with either on-off or hi-lo-off control. Lennox blowers combined with the GSDI give a large range of sizes and air volumes to meet almost any need.

### *Landmark equipment*



. . . a system of matched, commercial quality components that provide heating, cooling, air handling. Air mixing is provided by outside air dampers built as an integral part of the Landmark system. Each component is available in various capacities to provide exactly the right combination of heating, cooling and air handling. The components can be stacked vertically to provide up-flo or down-flo operation in a single unit. Landmark can be used singly or in multiples for multi-zone operation. Heat exchangers are aluminized. Landmark units operate at low sound levels and are completely insulated, making them suitable for installation in restaurants and other public buildings. Available from 68,000 to 340,000 Btuh gas input.

### *Horizontal oil furnaces*

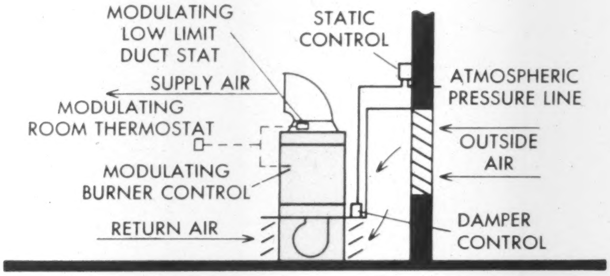
. . . where space is at a premium and capacity demands are not too great, the Lennox OS5 and OS6 furnaces are an ideal solution. These units have large capacity blowers and filters. They use stainless steel primary heat exchangers and are not affected by direct exposure to outside air. The dual limit controls on the OS6 provide guaranteed temperature protection, even in the event of a reverse flow condition. The horizontal oil units range from 119,000 to 350,000 Btuh input with constant ignition and two stage oil pump as standard.

## DO YOUR BUILDINGS NEED MAKE-UP AIR?

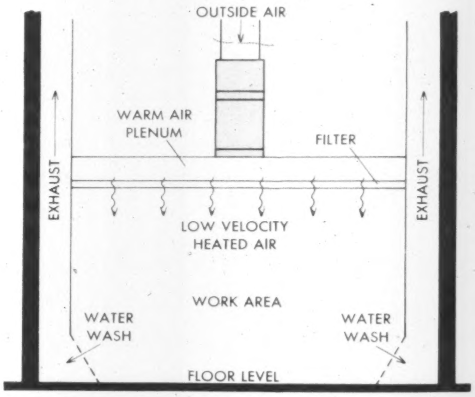
In many buildings an exhaust system pumps out contaminated air, leaving a negative pressure inside. Too often, replacement of this air is left to infiltration, which is highly inadequate. It starves the exhaust system by making it work against its own negative pressure, causes drafts and serious temperature control problems.

### *Lennox experience in make-up air systems can help you. Here are valuable tips:*

- Usually you should maintain a slightly positive pressure within confined areas to prevent excessive infiltration and to insure proper operation of process work such as paint spray booths. Size the make-up air system to provide about 10% more air than is exhausted. Btuh output of the make-up air heater equals Cfm x 1.08 x difference between exhaust air and outside design temperatures.
- Introduce make-up air only when the exhaust system is operating. Use dampers to regulate the fresh air intake. There are three basic damper controls: Manual — low cost, but least desirable. Motorized damper interlocked with the exhaust system — use where exhaust volume is constant. Motorized damper actuated by a pressure sensing device — use where the exhaust volume varies.
- There are two preferred burner control types for make-up air systems: Hi-lo-off — used where close temperature control is not required. Modulating—used for close temperature control. For either type, a ductstat controls the discharge air temperature. If the make-up air heater also provides space heating, other controls may be needed.


MODULATING LOW LIMIT DUCT STAT
STATIC CONTROL
SUPPLY AIR
ATMOSPHERIC PRESSURE LINE
MODULATING ROOM THERMOSTAT
OUTSIDE AIR
MODULATING BURNER CONTROL
RETURN AIR
DAMPER CONTROL

Typical combined space heating and make-up air system.


OUTSIDE AIR
WARM AIR PLENUM
FILTER
EXHAUST
EXHAUST
LOW VELOCITY HEATED AIR
WORK AREA
WATER WASH
WATER WASH
FLOOR LEVEL

Typical paint spray booth make-up air system.

- **direct-fired vs "wet" industrial heating**
- **heating and air conditioning**

* **make-up air and ventilation**

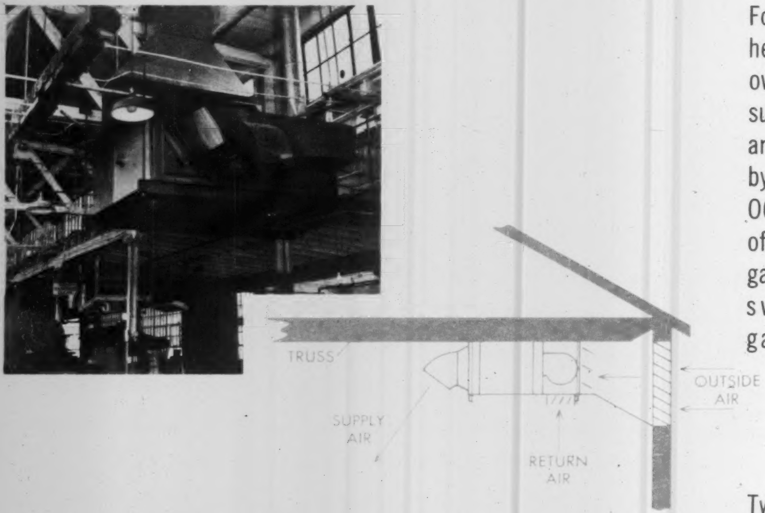
- **process work**
- **space heating**

No. 3 of a Series

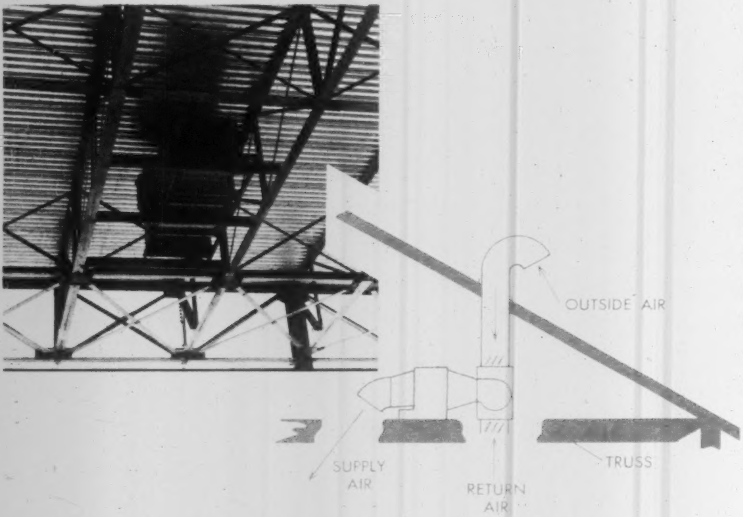
**LENNOX**

**Commercial Equipment**

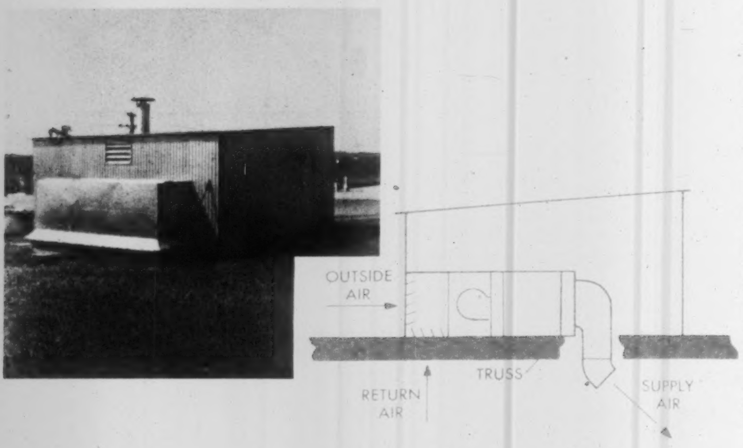
# Actual Installations of Lennox Make-up Air and Ventilation Equipment



Four Lennox OG4 units provide space heating and make-up air for paint drying ovens in a large Iowa factory. They are suspended to save floor space. Dampers are coordinated with the drying ovens by a modulating motor and a time clock. OG4 units were used to take advantage of the lower rates for an interruptible gas supply. The OG4 provides instant switch-over between oil and gas with no burner changes.



Twenty-two Lennox GSDI duct furnaces combined with Lennox high capacity blowers and modulating dampers heat a Canadian factory and provide make-up air. Each duct furnace has 420,000 Btuh input and Hi-lo-off control. All units were factory assembled on frame rails and shipped to the job-site wired, piped, tested and ready for firing. This was extremely important as the installation was made in the winter, and temporary heating was required. The mechanical contractor was able to install and start up the units in record time.



Here, rooftop installation saves space and simplifies taking outside air into the system. It provides heated air to replace exhausted contaminated air in a Michigan plant which welds and fabricates steel. The dampers are controlled by a static pressure regulator and a modulating damper motor since exhaust air volume is not constant. The modulating gas-oil burner is controlled by a primary thermostat in the work area, and a secondary ductstat that senses the discharge air temperature.

**LENNOX Industries Inc.**

MARSHALLTOWN, IOWA • COLUMBUS, OHIO • SYRACUSE, N.Y. • FORT WORTH, TEXAS • LOS ANGELES, CALIF. • SALT LAKE CITY, UTAH
DES MOINES, IOWA • DECATUR, GEORGIA • LENNOX INDUSTRIES (CANADA) LTD., TORONTO, ONTARIO • CALGARY, ALBERTA

LITHO U.S.A.

FORM NO. IND.-603-M6

**HERE'S WHY SO MANY ENGINEERS SPECIFY**

# Phelps Dodge Copper Tube for refrigerating, air conditioning and heating units!

1 Phelps Dodge has complete control of its copper tube from original source to finished product. The copper used in Phelps Dodge tube comes from Phelps Dodge-owned open-pit mines, is smelted in Phelps Dodge refineries and fabricated in modern Phelps Dodge mills. This overall Mine-to-Market control is assurance of highest quality and finest workmanship.

2 Phelps Dodge devotes particular attention, throughout fabrication, to uniform anneal for tube flaring and careful control of die draw for close tolerance.

3 Phelps Dodge can supply maximum tube lengths and precise wall thicknesses engineered to customer specifications; straight length tube tempered to meet bending and expanding requirements.

4 Phelps Dodge multiple mill operation guarantees a steady source of tube supply to meet the needs of manufacturers and distributors of refrigerating, air conditioning and heating equipment.

*It's the famous Mine-to-Market Quality Line . . .*
*sold the quality way—through authorized wholesalers!*

AIR-CONDITIONING AND REFRIGERATION WHOLESALERS
A-R-W
ASSOCIATE
MEMBER

**PHELPS DODGE COPPER PRODUCTS**
CORPORATION
New York, N. Y. • Los Angeles, Calif.

PHELPS DODGE COPPER PRODUCTS CORPORATION
PD
P
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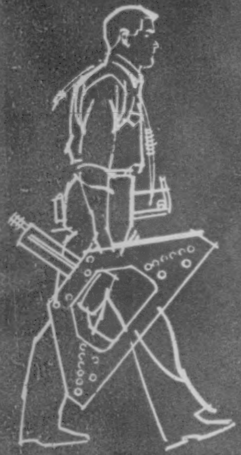
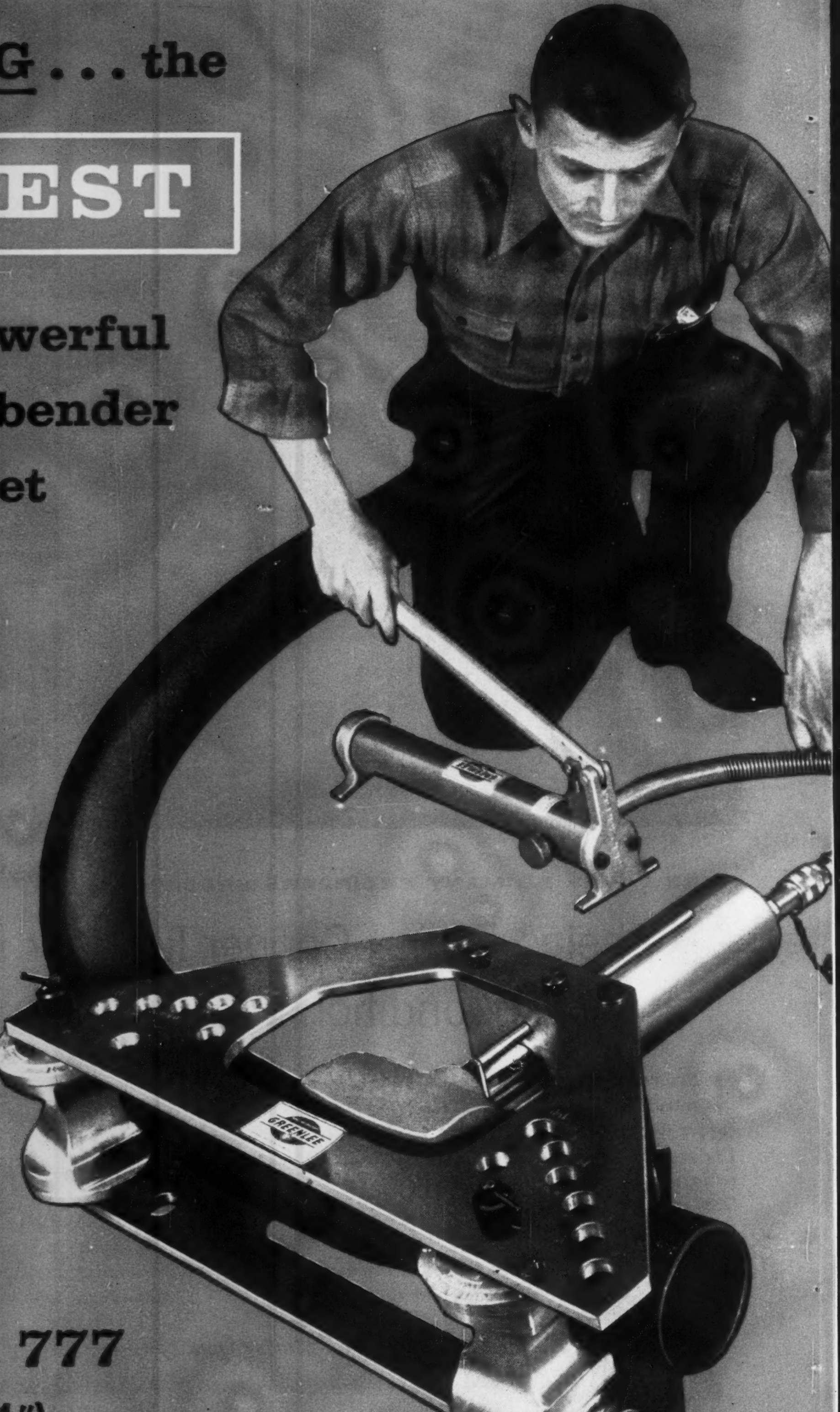
ANNOUNCING . . . the

LIGHTEST

and most powerful
4" segment bender
on the market



See this bender
demonstrated at the
NECA SHOW,
October 24-26, 1960—
BOOTH 155-157

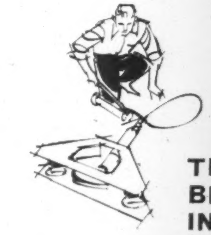


Greenlee No. 777
(1-1/4" thru 4")
weighs only 65 lbs.
*(exclusive of shoes)*

**COMPARE** THESE IMPORTANT ADVANTAGES . . .

**FEWER PARTS**

one-piece frame of high-strength aluminum
one set of aluminum pipe supports for all pipe sizes
one set of safe, quick-locking pipe support pins.



**THREE BENDERS IN ONE**

a few optional parts adapt the No. 777 segment bender to fast, one-shot 90° bending 1/2" thru 2" and thin-wall bending 3/4" thru 2".

**SAFE, ONE-MAN OPERATION**

safety valve in pump, oil by-pass in ram, weighs only 65 lbs. excluding bending shoes.

Unmatched for over-all performance, the new Greenlee No. 777 does more jobs for you than any other bender of its type. Use it to make offsets . . . large sweeps . . . concentric bends . . . one-shot 90° bends . . . thin-wall bends.

Its 27-ton ram has power to spare for segment bending of steel or aluminum conduit and pipe 1-1/4" thru 4" — will bend extra heavy schedule 80 pipe. Comes equipped with a hand hydraulic pump, but can be operated with power pump for even faster performance.

**OPTIONAL EQUIPMENT FOR ONE-SHOT AND THIN-WALL BENDING**

**One shot 90° bending 1/2" thru 2"**

**90° bends in one shot** An important *exclusive* advantage you get with this new, lightweight GREENLEE segment bender. Simply by adding bending shoes and adapter, you can make any bend up to 90° in 1/2" thru 2" conduit or pipe in *one shot!*

**Thin-wall bending 3/4" thru 2"**

**Quickly mounted thin-wall attachment** The No. 777 segment bender can be quickly and economically converted to bend thin-wall conduit 3/4" thru 2". Standard No. 770 thin-wall attachments fit the No. 777 bender with only the addition of one roller.

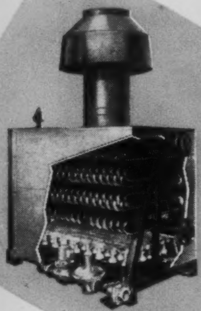
**ASK YOUR DISTRIBUTOR FOR A DEMONSTRATION NOW! Write for bulletin E-249**

GREENLEE TOOL CO., 1887 Columbia Ave., Rockford, Illinois

TOOLS FOR CRAFTSMEN
GREENLEE ® JOB-PROFIT TOOLING
. . . cost control for contractors

**PARKER INDUSTRIAL HOT WATER BOILER**

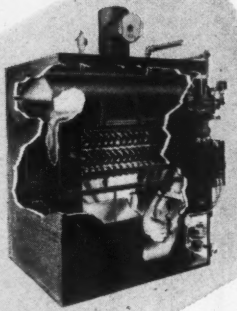
126M to 5,000M B.T.U. Designed specifically for closed circuit application such as building heating and industrial processing. Also available for high temperature liquids up to 600°. Gas, oil and combination gas-oil fired.

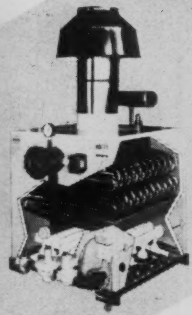


*Specify*
*Install*

**PARKER HORIZONTAL DRUM STEAM BOILER**

69 to 150 H.P. Full steam pressure generated in less than 10 minutes. Completely packaged for simplicity of installation. Complete internal accessibility. Available in gas, oil, or combination gas-oil firing.

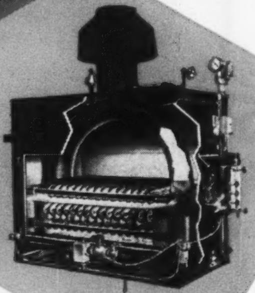




**PARKER INDIRECT HOT WATER BOILER**

Manufactured in 4 sizes, 264M to 1,152M B.T.U. or 254 to 1,105 gallons per hour 100° rise. The ideal boiler to provide economical rust-free hot water service for swimming pools, apartments, hospitals, laundries, etc. Gas fired only.

**PROVEN**
**PARKER**
**PRODUCTS**



**PARKER U-DRUM STEAM BOILER**

5 to 40 H.P. One of the most popular boilers ever manufactured. Used in all types of industry. Available for gas, oil or combination gas-oil firing.

*Designed to Do the Job Better*

*A few territories are available for qualified manufacturer's representatives.*

Please send me latest information and colorful bulletins on...

☐ Parker Hot Water Boilers
☐ Parker U-Drum Steam Boilers
☐ Parker Horizontal Drum Steam Boilers
☐ Parker Indirect Hot Water Boilers

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City State

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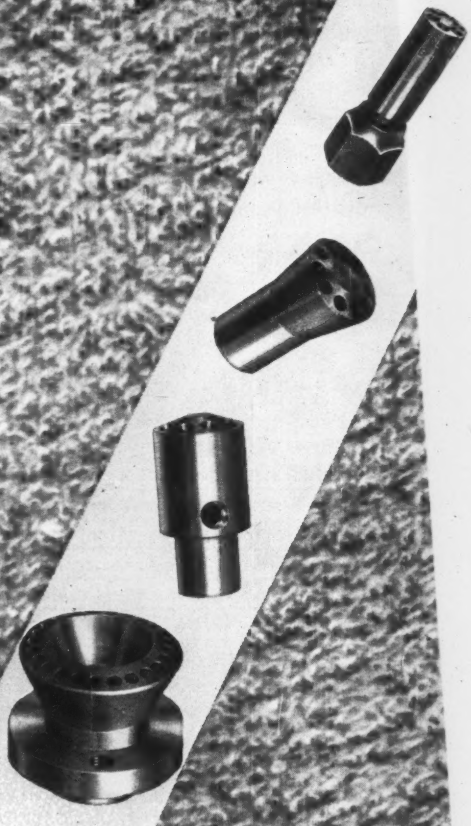
MFG. CO.
2035 East 37th St., Los Angeles 58, Calif.
ADams 3-8263

# the "famous firsts" of

# SPORLAN DISTRIBUTORS give you Peak Performance on All Installations



**1939**
Replaceable Nozzle
First Independent Supplier

**1948**
Steel body for Ammonia

**1955**
Aluminum body for Freon and Ammonia

**1956**
Distributors...with Auxiliary Side Connections for reverse cycle (heat pump) hot gas defrost and hot gas by-pass systems.

Modifications will always be made, but only to improve the product... never to change it!

**See your friendly SPORLAN WHOLESALER for Bulletin 20-10 Today!**

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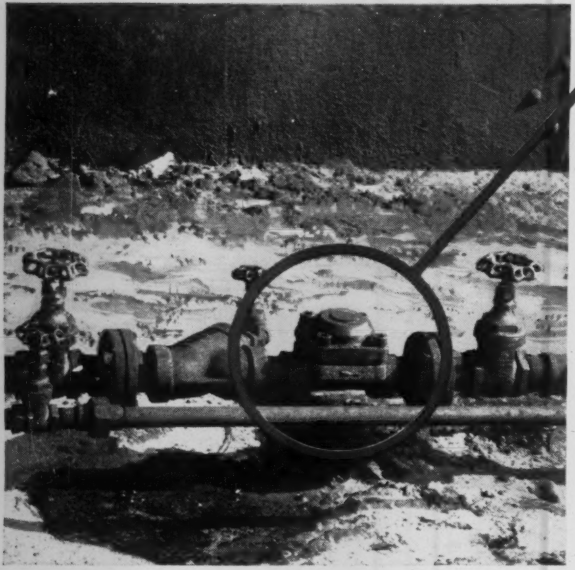
*EXPORT DEPT. 85 BROAD ST., NEW YORK 4, N. Y.*

# YARWAY Y news briefs

*from* **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

*BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD • STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS*



## THIS STEAM TRAP WILL DISCHARGE 25,500 LBS. OF CONDENSATE PER HOUR

This is a typical installation of a Yarway Series 40 Impulse Steam Trap—a trap designed specifically to gobble up extra heavy condensate loads.

The trap is a No. 48, 2½" size, and is installed on a suction heater connected with an 86,000 barrel tank containing fuel oil at a storage terminal. The operating pressure is 13 psi. At this pressure the trap has a capacity of 25,500 lbs. continuous discharge of condensate per hour.

At operating pressure of 100 psi, the trap's capacity is 62,000 lbs. per hour.

### CAPACITY–PLUS

Capacity isn't the whole story on Yarway Series 40 Steam Traps. Like all Yarway Impulse Traps, they offer advantages like quick heat-up, even temperatures, small size, good for all pressures, non-freezing.

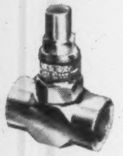
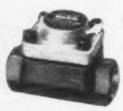
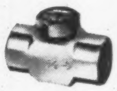
Series 40 traps also feature high temperature discharge characteristics, excellent low pressure operation, no airbinding, operation against back pressures up to 40%, and stainless steel construction.

You can get Yarway's latest steam trap Bulletin T-1743, or arrange for a free 60-day trial of a Yarway Impulse Trap, by writing to Yarnall-Waring Company or contacting your local Industrial Distributor.

YARNALL-WARING CO. PHILA. U.S.A.
1½" NO. 40
YARWAY
HIGH CAPACITY
IMPULSE STEAM TRAP
MAX. PRESS. 600

*Yarway ½" No. 40 Impulse Steam Trap (shown actual size). Also available in ¾", 1½", 2" and 2½" sizes.*

**YARWAY OFFERS IMPULSE STEAM TRAPS FOR THESE SPECIFIC OPERATING CONDITIONS**

| AVERAGE CONDENSATE LOADS | EXTRA HEAVY CONDENSATE LOADS | LIGHT CONDENSATE LOADS |
|---|---|---|
|  |  |  |
| Series 60 | Series 40 | No. 30 |

# IT MAKES SENSE !

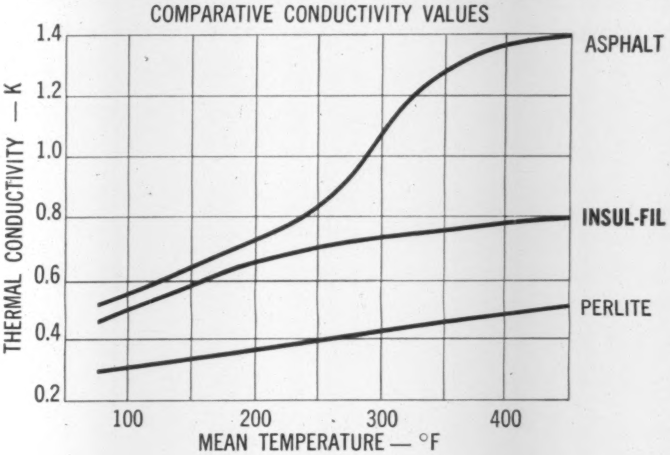
## TO INSULATE UNDERGROUND PIPING WITH

# insul-fil®

**1** Introduction of a material such as expanded perlite into a granulated hard asphalt improves the insulating value of the blend.

**2** Proper selection of asphalts by softening point to make up asphalt-perlite blends improves the insulating properties of the blend.

**3** Introduction of an aggregate, such as perlite, into a granulated asphalt improves the mechanical properties of the blend once it is plasticized.



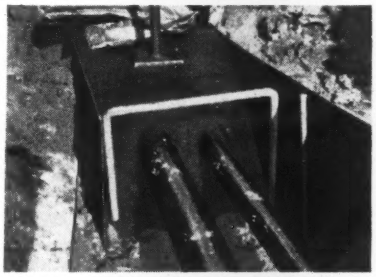
After years of extensive testing conducted at the Research and Development Department of The Atlantic Refining Company, these conclusions were presented in a Paper given before the American Chemical Society in Dallas, Texas, April, 1956. Since that time, hundreds of Insul-fil field installations have confirmed these conclusions.*

It is a well-known fact that the use of asphalt in construction created the necessity for the introduction of fillers (usually inorganic) of various types for the purpose of arresting the flow characteristics and improving the insulation value of the asphalts themselves.

The blend of hard granular asphalt and asphalt coated perlite gives Insul-fil its excellent insulating properties, water resistance and sufficient structural strength to the insulating body to resist normal soil stresses with the steam on or off.

An important Insul-fil development is the priming of the pipe with Accelerator #7591. The use of accelerator provides continuous adhesion of Insul-fil to the pipe, hastens consolidation, and gives additional protection against corrosion by galvanic action.

**Paper available on request.*



**Insul-fil Is Simple To Install**

Just pour it around the pipe to be insulated. Prod and tamp it in place and backfill. Heat introduced into the pipe forms the conduit.

**Insul-Fil Company Inc.**
250 Pettit Avenue
Bellmore, Long Island, N. Y.

Please send literature.

NAME____________________

COMPANY____________________

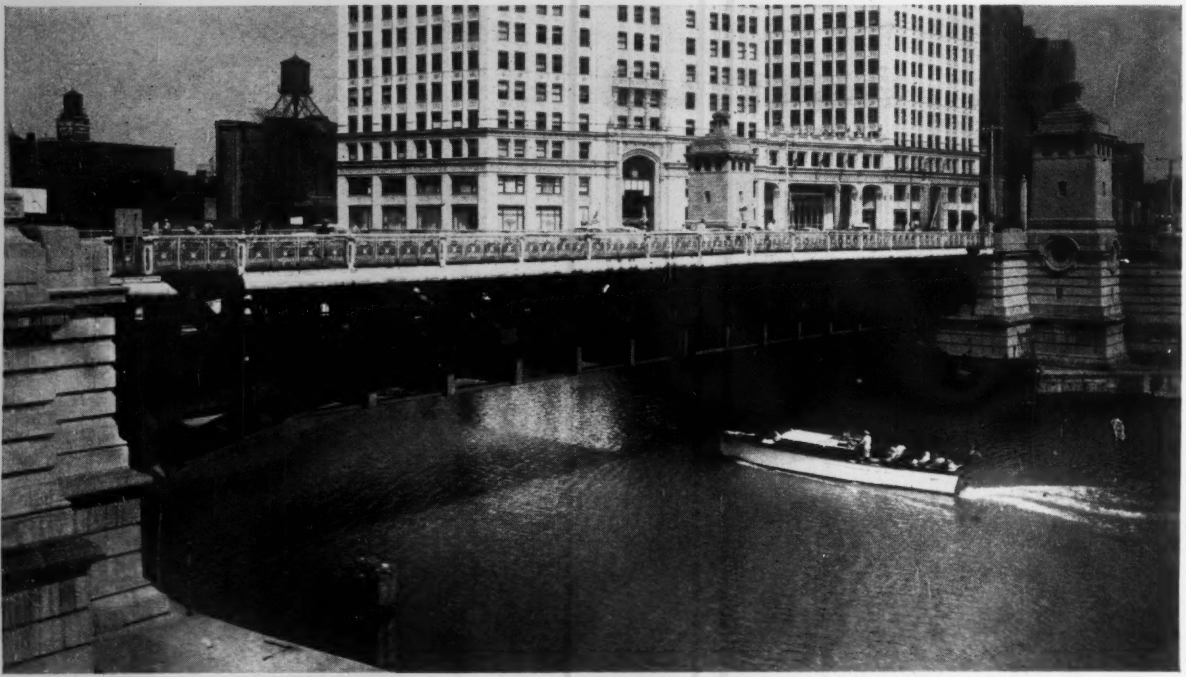
ADDRESS____________________

CITY__________ ZONE_____ STATE__________

# insul-fil

***The most efficient Granular Fill Type Insulation for Hot Underground Piping***

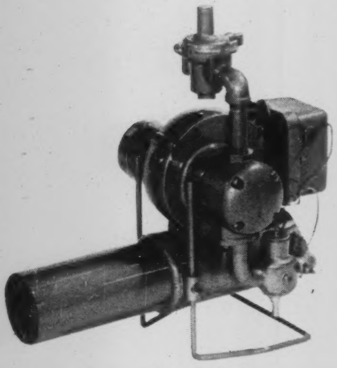
**Insul-Fil Company Inc.** DIVISION OF: MIRACLE ADHESIVES CORPORATION, 250 PETTIT AVENUE, BELLMORE, LONG ISLAND, N. Y.



## FAMOUS MICHIGAN AVENUE BRIDGE TOWERS HEATED BY

# LO-BLAST *ECONOMITE*

## POWER GAS CONVERSION BURNERS



**ECONOMITE POWER GAS BURNER**

The *Economite* is made in capacities from 75,000 to 700,000 BTU/hr. input. *Standard* Lo-BLAST burners are available in capacities from 100,000 to 20,000,000 BTU/hr. input.

The north and south control towers of Michigan Avenue Bridge, at the foot of Chicago's "Magnificent Mile," are now heated dependably, economically by Lo-BLAST Economite Power Gas Conversion Burners rated respectively at 300,000 and 700,000 BTU/hr. This is just one of several Lo-BLAST conversion jobs installed in Chicago bridge towers.

Lo-BLAST Power Gas Burners save money because they eliminate the fuel waste caused by uncontrolled draft. When a *power* type burner shuts off, there is no rush of draft air to carry heat up the chimney, a condition which causes serious fuel waste.

The Lo-BLAST Burner does not depend upon natural draft, but upon air supplied by a small *quiet* blower. It provides both primary and secondary combustion air *only when the burner is on.* When the burner shuts off, the flow of air shuts off. The heating plant thus retains much of its heat between operations.

Lo-BLAST Burners eliminate the need for high chimneys—"inshot" design and complete factory assembly reduce installation and maintenance costs. Each unit is factory tested on gas before shipment.

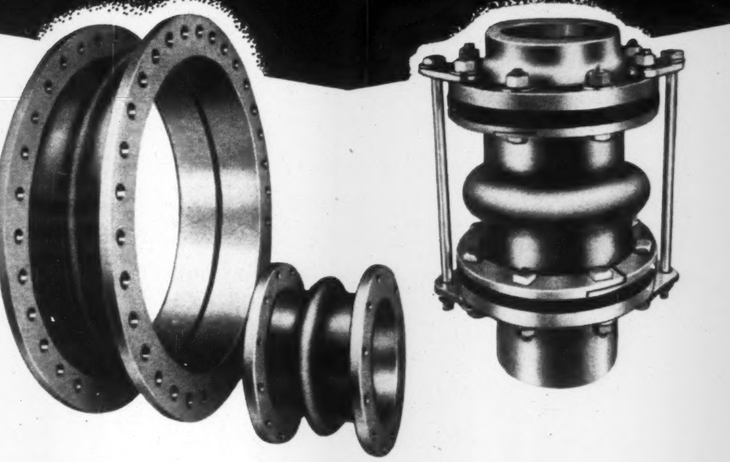
**Whatever you heat, you can do it for less with Lo-BLAST!**

**SEND TODAY FOR COMPLETE INFORMATION**

**MID-CONTINENT METAL PRODUCTS COMPANY**

1960 N. Clybourn Ave., Chicago 14, Ill.

# R/M Rubber Expansion Joints and Pipe Solve Piping Stress and Vibration Problems



R/M Rubber Expansion Joints *absorb* pipe movement. They respond to the slightest pressure . . . preventing stress and strain on pipe and fittings that can cause major trouble in ventilating and air conditioning systems. R/M Rubber Joints also *insulate* system components against destructive vibration and noise. Where space is limited or equipment is operated above rated capacity, R/M Rubber Expansion Joints compensate for misalignment due to stress loading. They are available in a wide range of natural and synthetic rubber types for use with gases, fluids or semi-fluids over a temperature range to 200° F.

**Condor Flexible Rubber Pipe** is ideal for pipe lines subject to noise, vibration, electrolysis, corrosion, abrasion or taking backbends. It will outlast iron or steel—eliminate leaky joints at bends. Let an R/M Distributor discuss with you the advantages of R/M Rubber Expansion Joints, Condor Flexible Rubber Pipe and other R/M rubber products for your heating and cooling applications. Write for Bulletin M685.

## R/M POLY-V® DRIVE

*Single, Parallel V-Ribbed Belt*

- MORE POWER—LESS SPACE
- CONSTANT SPEED RATIO
- ELIMINATES MULTIPLE V-BELT "MATCHING" PROBLEMS
- MAINTAINS GROOVE SHAPE
- LESS BELT AND SHEAVE WEAR
- LESS INVENTORY (2 cross sections instead of 5)

***CONVERT TO POLY-V and BE SURE!***

## CONDOR V-BELTS

*For Heavy Industrial Multiple Belt Units*

- 40% MORE H.P. AT STANDARD V-BELT PRICE
- PRECISION MADE
- SMOOTHEST RUNNING V-BELTS MADE
- MORE GRIP, LESS SLIP
- LONGER, TROUBLE-FREE SERVICE
- LOWER DRIVE COSTS

## NEW R/M CX V-BELT*

*For Light Duty Drives*

- EXTREMELY QUIET . . . VIBRATION-FREE
- ONLY FULLY-MOLDED, FULLY-JACKETED LUGGED V-BELT
- FOR SMALL PULLEYS
- FLEXIBLE, STRONG, RUGGED
- OUTLASTS OTHERS UP TO 8 TO 1
- NO FLEX-CRACKING
- HOLDS SHAPE AND EFFECTIVE LENGTH WITHOUT STRETCH

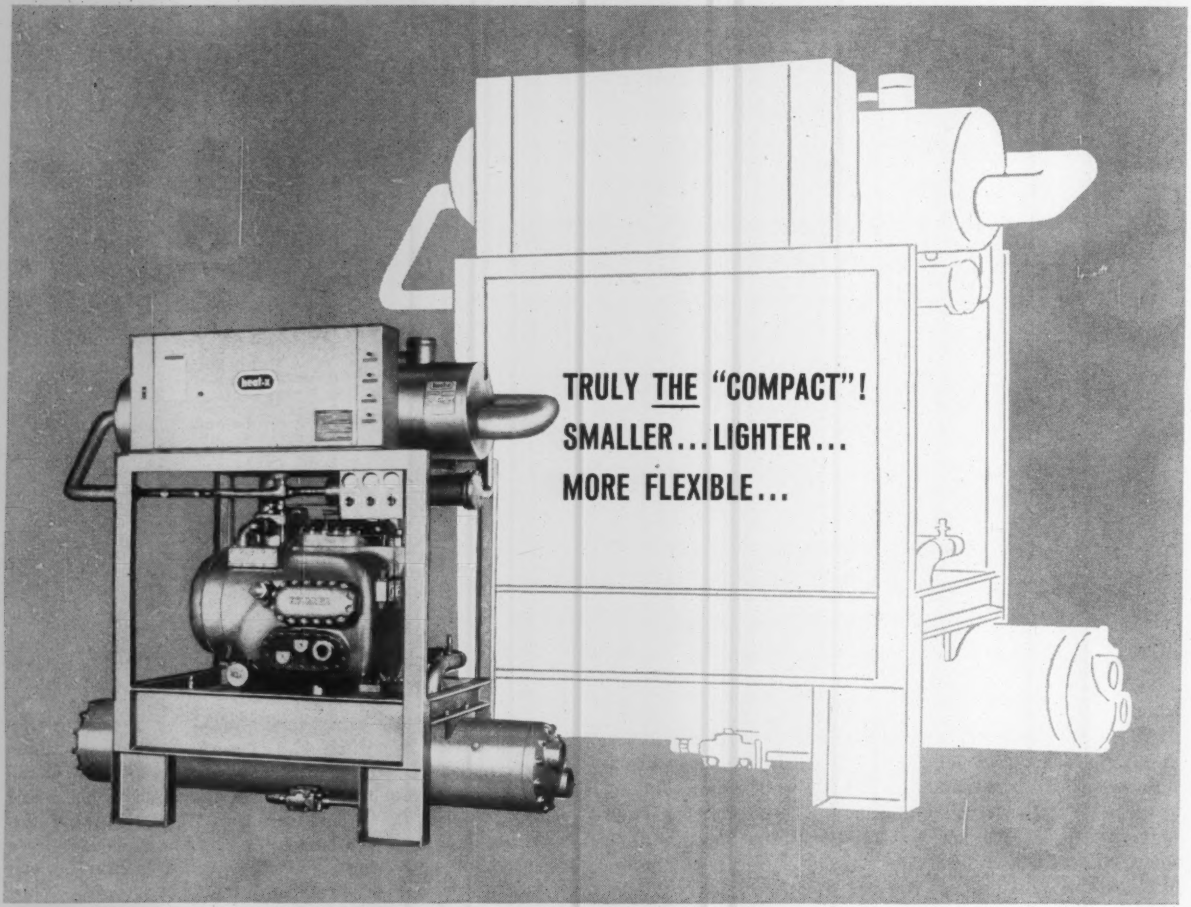
*Made for original equipment. Patented.

## RAYBESTOS-MANHATTAN, INC.

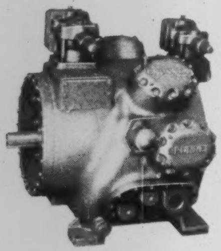
MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

RM1005

ENGINEERED
RUBBER
PRODUCTS
. . . MORE USE
PER DOLLAR



# NEW SPACE SAVING heat-x PACKAGE CHILLERS PACK MIGHTY COOLING CAPACITIES



**POWERED BY THE FAMOUS BRUNNER MULTI-DRIVE COMPRESSORS, (HERMETIC OR DIRECT-DRIVE TYPE) RENOWNED FOR FIELD-PROVEN DEPENDABILITY**

Greater cooling capacity with much less bulk—that's the story on this new line of Heat-X units for chilled water air conditioning and industrial water cooling applications.

Note the superior features of these ruggedly reliable, top performing chillers, available in capacities from 20 through 100 tons, completely self-contained, ready to install: Exclusive, space-saving Inner-Fin® chillers and heat interchangers • Chilled water passages of non-ferrous construction • Cleanable condenser-receivers • Capacity modulation and unloaded start • Indicator lights.

All necessary components . . . *often "extras" with others but always "standard" with Dunham-Bush* . . . include: gauges, thermostats, reversible oil pump, oil failure control, high-low pressure control, relief and purging valves, solenoids, expansion valves, filter-drier, liquid sight glass, control panel.

Though it's infrequently needed, when service is necessary it's simple. Just a glance at Heat-X Package Chillers shows the reach-in easiness for quick and economical servicing.

And don't forget, every part of every Heat-X Chiller is backed by a single source manufacturer's responsibility.

*Get the facts. Request Heat-X Form No. 8023A.*

**Dunham-Bush, Inc.**

WEST HARTFORD 10 • CONNECTICUT • U. S. A.

**DUNHAM-BUSH**

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER
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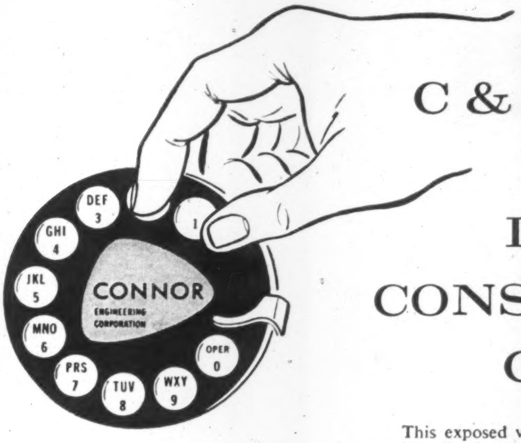
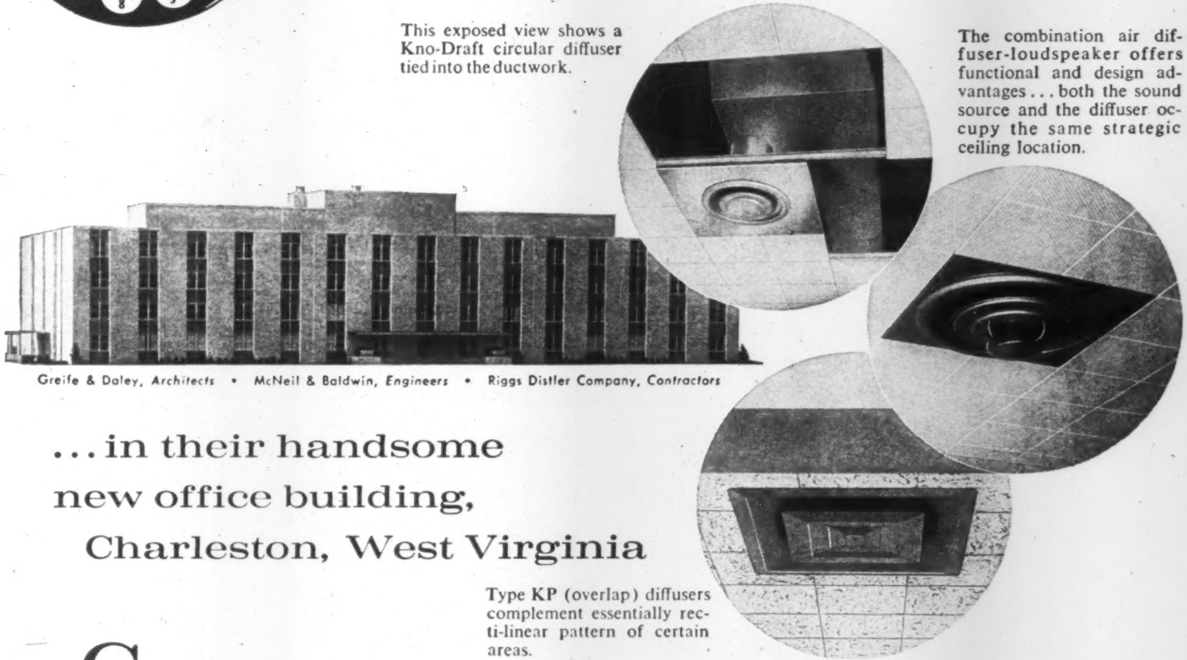


# C & P Telephone Company of West Virginia Dialed "C" for CONSTANT COMFORT CONDITIONS



This exposed view shows a Kno-Draft circular diffuser tied into the ductwork.

The combination air diffuser-loudspeaker offers functional and design advantages . . . both the sound source and the diffuser occupy the same strategic ceiling location.

Greife & Daley, Architects • McNeil & Baldwin, Engineers • Riggs Distler Company, Contractors

Type KP (overlap) diffusers complement essentially recti-linear pattern of certain areas.

## . . . in their handsome new office building, Charleston, West Virginia

Commonly these days, business and industry call on leaders like Connor to provide new or remodeled buildings with modern interior atmospheric comfort that matches the modernity of architectural design.

Here in this new 4-story office building, for example, more than 800 various Connor units have been entrusted with the 'round-the-calendar job of giving the Telephone Company's employees a comfortable climate in which to work. In addition to producing effective air distribution, the Kno-Draft squares and rounds—with their clean, simple lines—blend neatly with the building's interior . . . and 230 Kno-Draft loudspeaker diffusers enable installation of both communication and comfort sources in the same strategic ceiling locations . . . just one installation hole for two separate, vital functions.

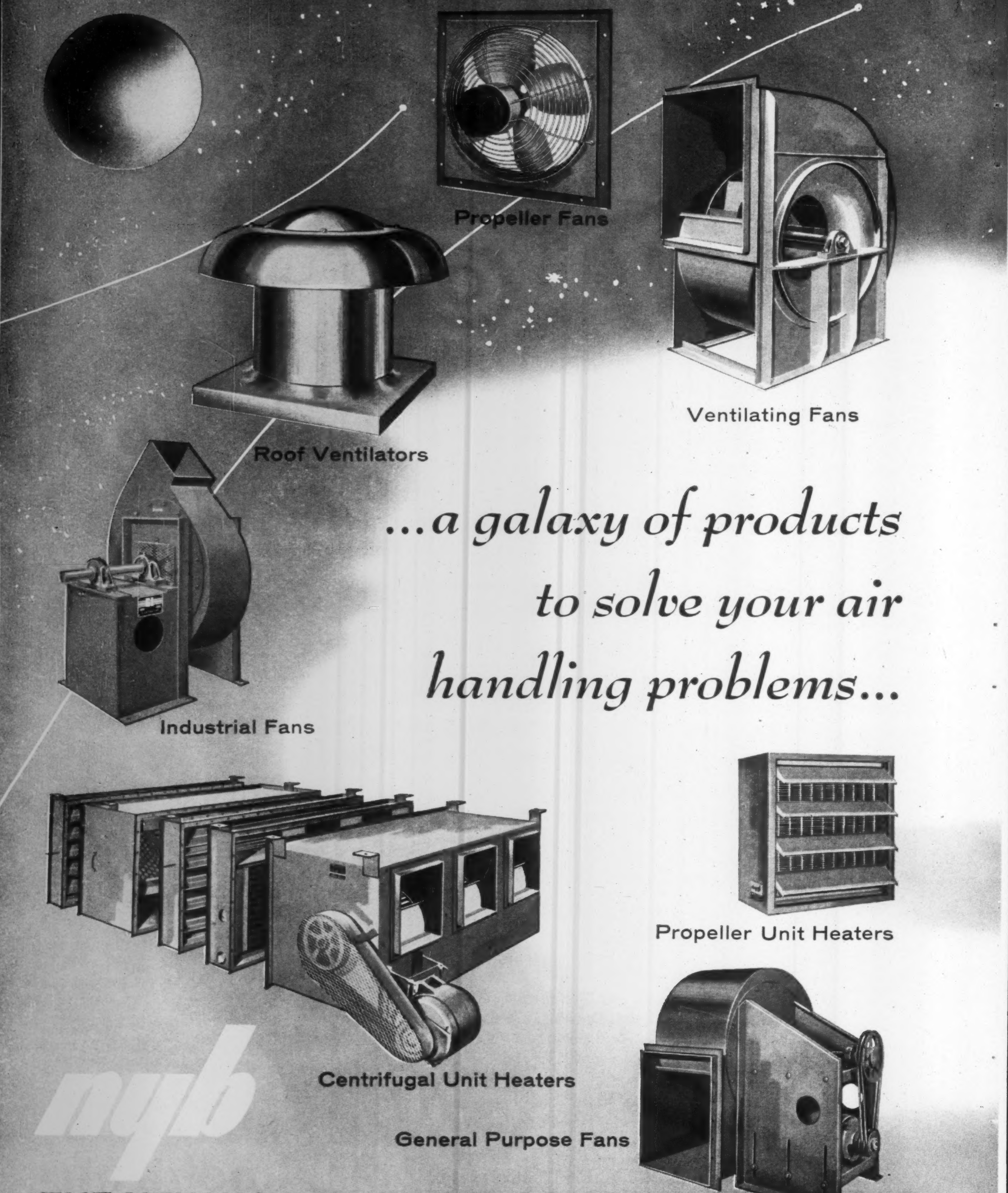
Seeking proper design and perfect function, architect, engineer, and contractor can choose confidently from the Kno-Draft line . . . can be sure that his choice will have the others' approval and will delight the client. Write for complete information.

*CONNOR . . . for Constant Comfort Conditions*

CONNOR
ENGINEERING CORPORATION

**kno·draft®**
air diffusers

**CONNOR ENGINEERING CORPORATION**
DANBURY • CONNECTICUT


Propeller Fans
Ventilating Fans
Roof Ventilators
...a galaxy of products to solve your air handling problems...
Industrial Fans
Propeller Unit Heaters
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nyb
General Purpose Fans

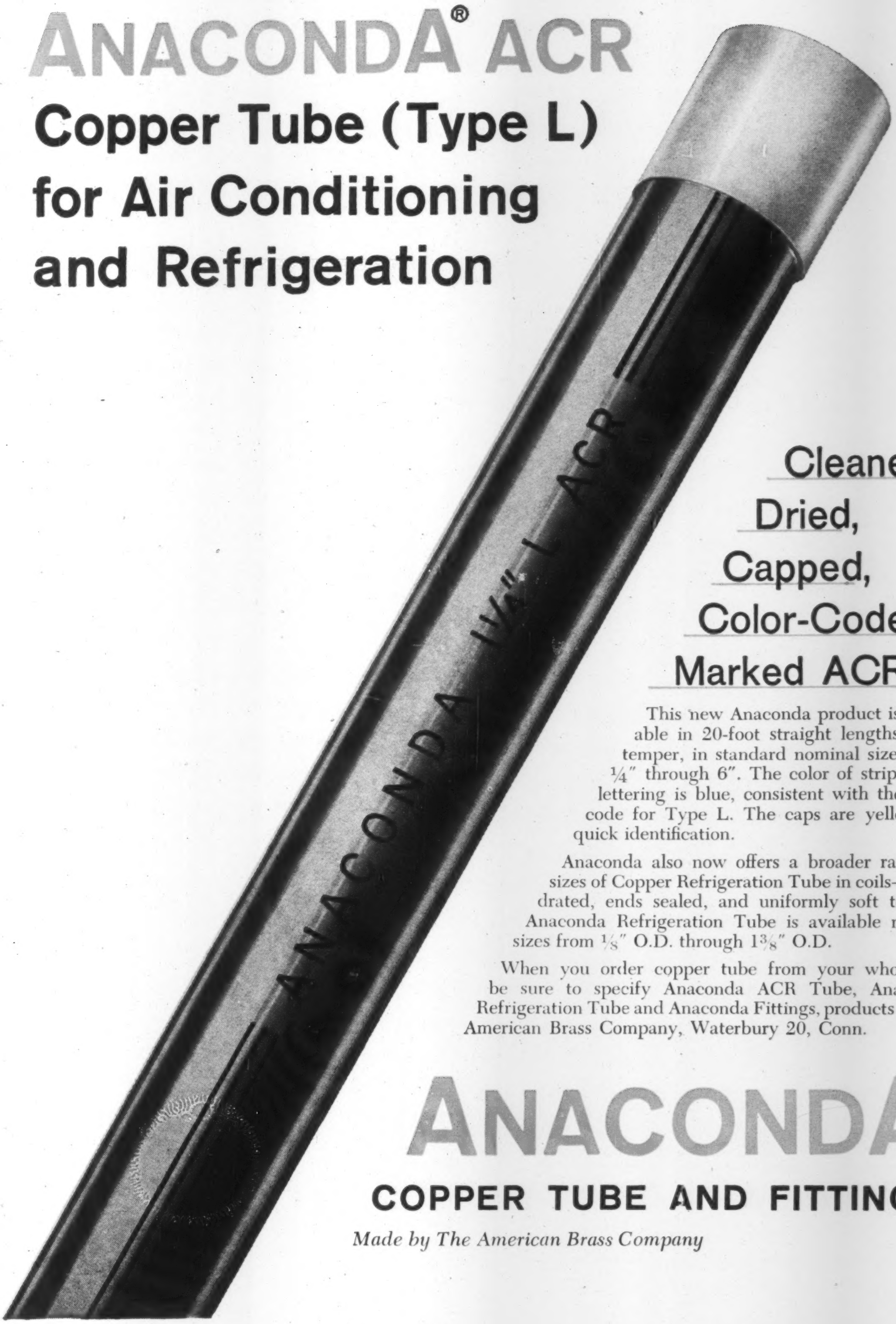
**THE NEW YORK BLOWER COMPANY**

**Sales offices: 3149 South Shields Avenue • Chicago 16**

Now available

ANACONDA® ACR

Copper Tube (Type L)
for Air Conditioning
and Refrigeration



Cleaned,
Dried,
Capped,
Color-Coded,
Marked ACR.

This new Anaconda product is available in 20-foot straight lengths, hard temper, in standard nominal sizes from ¼″ through 6″. The color of stripes and lettering is blue, consistent with the color code for Type L. The caps are yellow for quick identification.

Anaconda also now offers a broader range of sizes of Copper Refrigeration Tube in coils—dehydrated, ends sealed, and uniformly soft temper. Anaconda Refrigeration Tube is available now in sizes from ⅛″ O.D. through 1⅜″ O.D.

When you order copper tube from your wholesaler be sure to specify Anaconda ACR Tube, Anaconda Refrigeration Tube and Anaconda Fittings, products of The American Brass Company, Waterbury 20, Conn. 6029

ANACONDA®

COPPER TUBE AND FITTINGS

*Made by The American Brass Company*

With a draft diverter these are
nothing but smoke stacks.
Specify instead a
FIELD DRAFT CONTROL
and they become
true chimneys
. . . an abundant, unfailing source
of draft, precisely controlled to
the needs of gas combustion
field
FIELD CONTROL DIVISION, Conco Engineering Works, Inc. — Mendota, Illinois
AFFILIATES: Spartan Tool Division - Powered Sewer Cleaning Equipment - Material Handling Division - Cranes, Hoists - Conco Building Products, Inc. - Brick, Tile, Stone

SONOCO
SONOAIRDUCT®
FIBRE DUCT

## Time-Saving Dollar-Stretcher On Slab Perimeter Jobs

Contractors and owners everywhere are cutting costs by using Sonoco Sonoairduct Fibre Duct in slab perimeter heating, cooling, and combination systems.

It's easy to see why. Sonoairduct is not only low in cost, but is also lightweight for easier handling, joining, and leveling. Long lengths mean fewer joints, and it can be cut to size with a hand saw when necessary. With Sonoairduct, there are no dangerous sharp edges, and it won't chip, crack, or break when dropped . . . every piece is usable!

In addition to labor-saving economy, the consistent high quality of Sonoairduct means dependable performance in use—protects your reputation and the interests of your customers as well. Sonoairduct has been subjected to F.H.A. testing procedures, and meets or exceeds all F.H.A. criteria and requirements for products in this category.

So, save time, save labor, save *money* on your next slab perimeter job—use Sonoairduct Fibre Duct! Order required lengths or standard 18′ lengths, in 23 sizes from 2″ to 36″ I.D.

SONOCO
SONOAIRDUCT
FIBRE DUCT
INSTALLATION INSTRUCTIONS
PERIMETER SYSTEMS

**FREE INSTALLATION MANUAL**
Contains latest, detailed, step-by-step installation data for SONOAIRDUCT Fibre Duct. For free copy, send us your name and address on company letterhead.

*See our catalog in Sweet's, or write for complete information and prices to:*

**SONOCO**
Construction Products

**SONOCO PRODUCTS COMPANY, HARTSVILLE, S. C.** • La Puente, Calif. • Fremont, Calif. • Montclair, N. J. • Akron, Indiana
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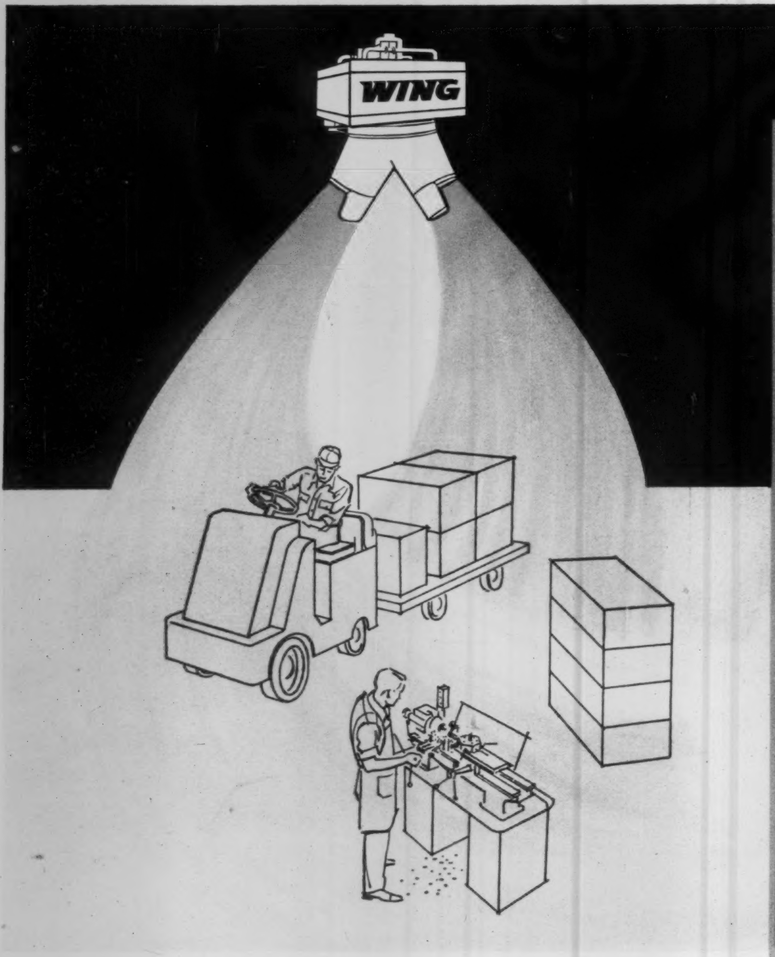

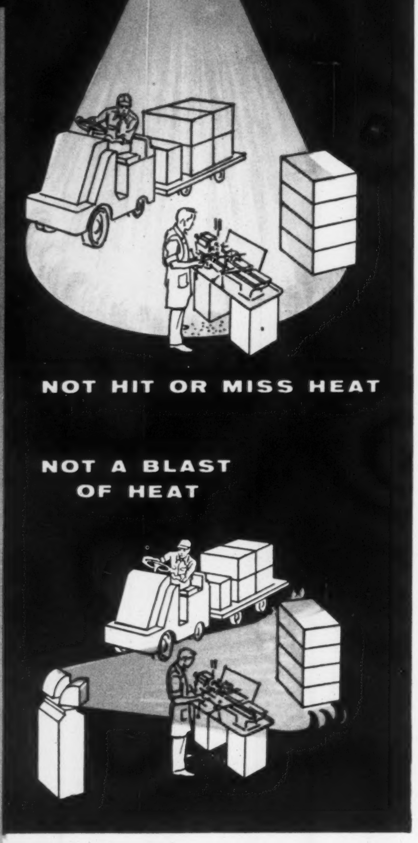
NOT HIT OR MISS HEAT
NOT A BLAST OF HEAT

# Only Wing Revolving Heaters Provide a Sweeping Flow of Perfect Heat

The unique slowly revolving discharge of Wing Heaters blankets the heating area—and does it more economically—than other heating units. With Wing Heaters, you can be sure that warm air is spread over the entire working area—throughout the occupancy zone, behind and around obstructions and into corners. There are no cold areas or torrid blasts as with other heater designs. Result? Workers are more comfortable and more productive.

Wing Revolving Units provide greater coverage—fewer units are needed—so, installation savings result. Standard units can be mounted from 8 to 65 feet. Higher mountings can be met if desired.

Wing Revolving Heaters have proved their outstanding performance in thousands of installations over many years of service life. They are easy to install, simple to maintain—and are available for steam, hot water or gas. Four types of revolving discharges are available to suit your requirements.

Write today for complete information telling how Wing Revolving Heaters can give you lowered costs and reliable operation.

**L. J. WING MFG. CO.**
DIVISION OF AERO SUPPLY MFG. CO. INC.
140 VREELAND MILLS ROAD, LINDEN, NEW JERSEY
FACTORIES: LINDEN, N. J. AND MONTREAL, CANADA
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**WING**

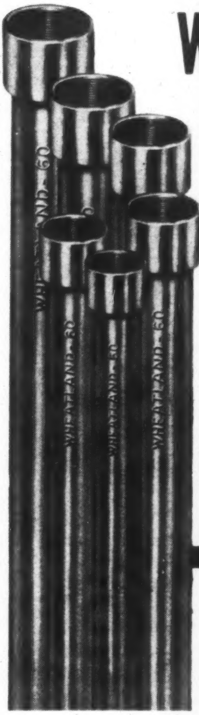
WC-142

# TEAMWORK PAYS OFF!

FOR YOU TOO!

...when you order your pipe through the

## WHEATLAND PRODUCER-JOBBER TEAM



INSIST
ON PIPE
MADE
IN U.S.A.

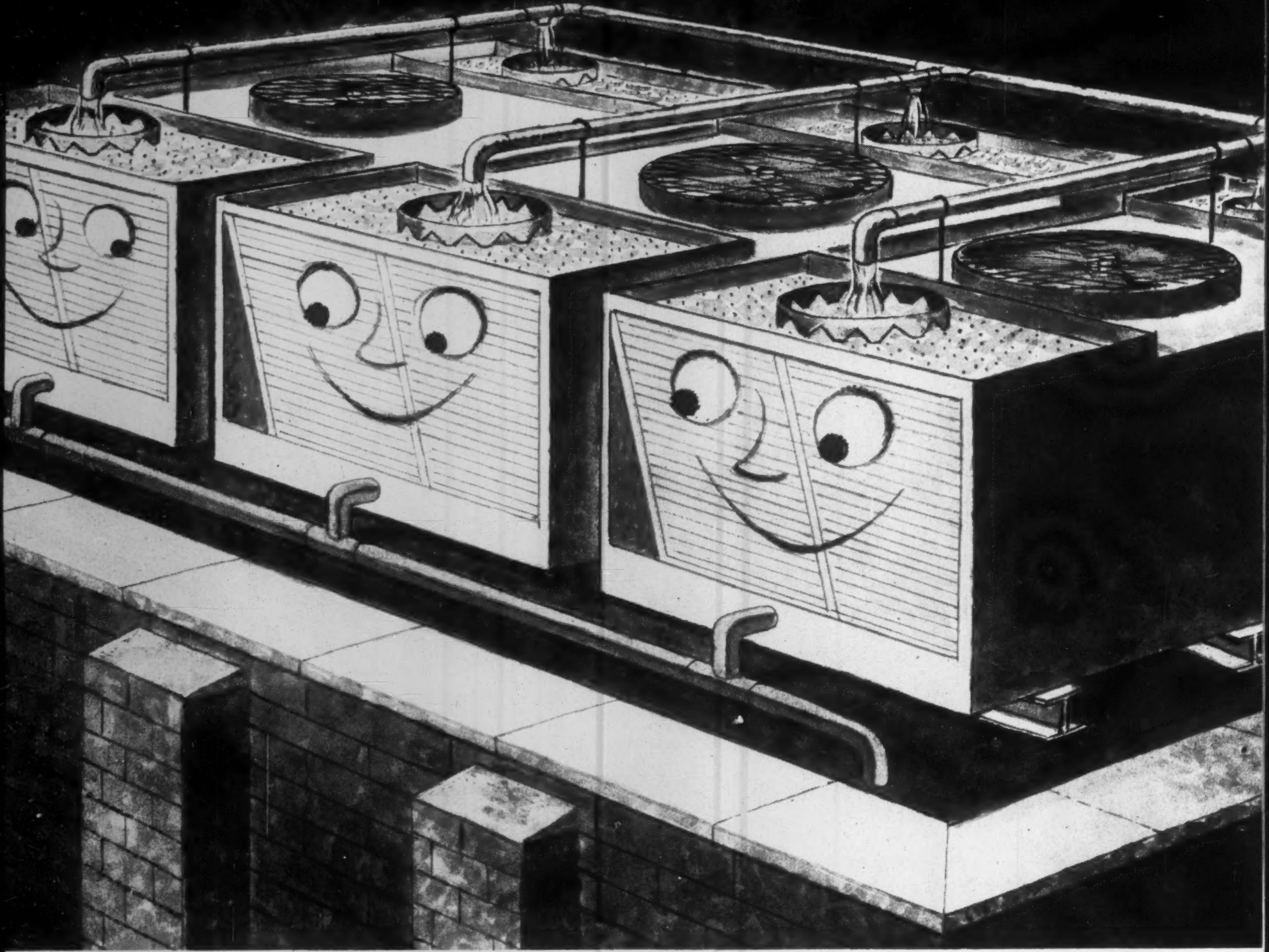
You can be sure this winning combination will supply you with steel pipe of unvarying high quality, job after job. And your Wheatland distributor sees to it that you get the pipe you need . . . on time!

*See your Wheatland Pipe Distributor for black or galvanized Wheatland Steel Pipe.*

*...pipe with the yearmark!*

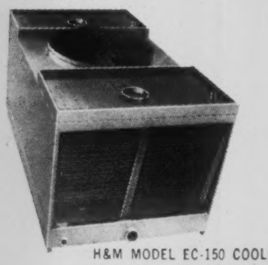
**WHEATLAND STEEL PIPE**

**WHEATLAND TUBE COMPANY**
Bankers Securities Bldg., Phila. 7, Pa.
MILLS: Wheatland, Pa. • Delair, N. J.



**How to cut costs on a 450-ton cooling job:**

*Use three Halstead & Mitchell 150-ton cooling towers!*



H&M MODEL EC-150 COOLING TOWER
WITH 10-GAUGE STEEL CABINET

HM
Halstead & Mitchell

How can three units be cheaper than one? Simple. Halstead & Mitchell packaged cooling towers come to you completely assembled and therefore less expensive to install. They operate at lower cost because there can be no wasted capacity; with step-control, you get capacity as you need it.

Furthermore, with "modular" units, you can place each tower near the equipment it's to be used with. This gives you closer control of water temperatures—another economy factor. Then, too, if one tower must be shut down, you can continue to operate the others.

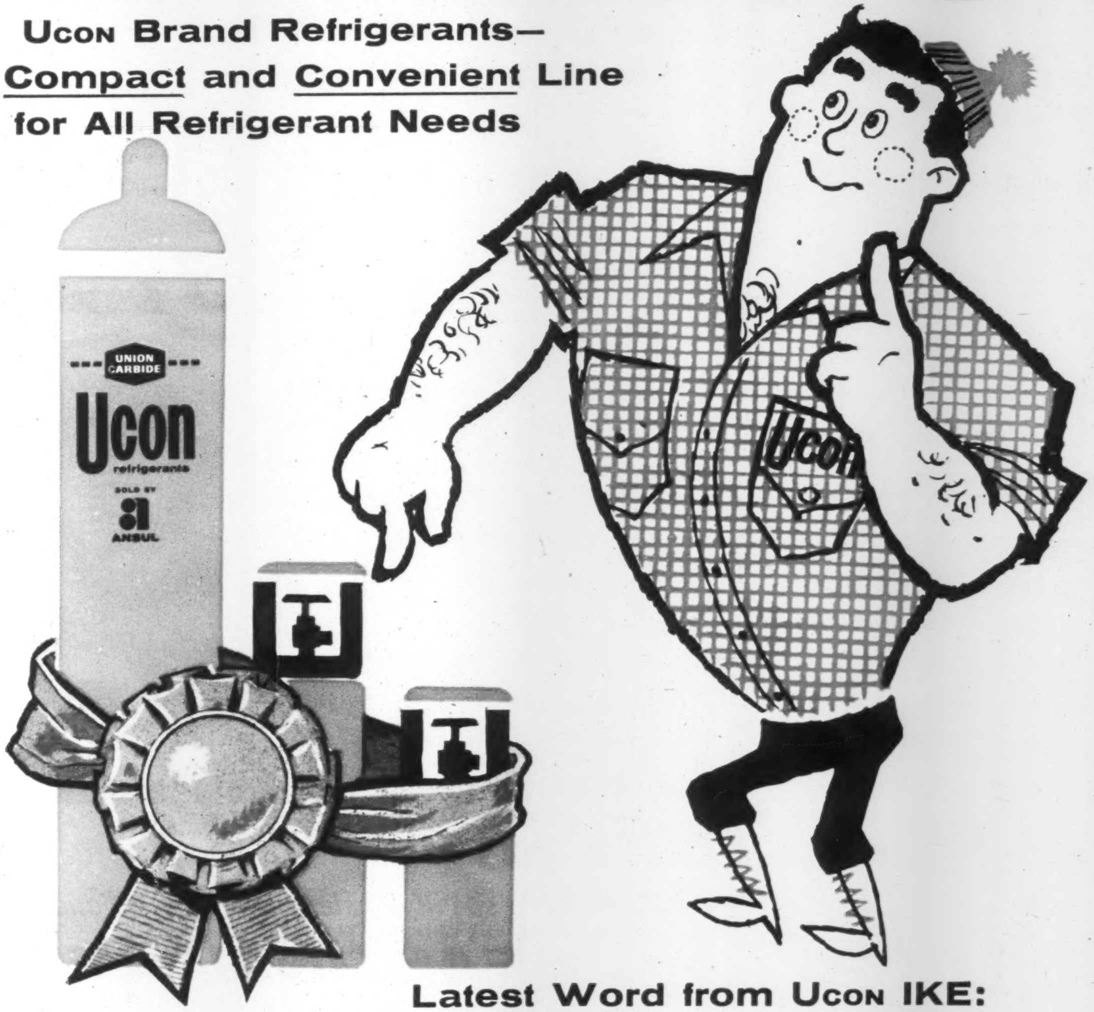
The advantages go on and on: lower silhouette, lower rigging costs, and utmost flexibility—towers can be easily moved or supplemented as requirements change. And, like all H&M towers, these carry the exclusive 20-Year Guarantee on the wetted deck against failure due to fungus attack or rotting.

Contact your Halstead & Mitchell distributor for complete information on H&M cooling towers in 3- to 150-ton capacities. Or write Halstead & Mitchell Co., Bessemer Bldg., Pittsburgh 22, Pa.

Cooling Towers • Water-Cooled Condensers • Air-Cooled Condensers • Finned Coil Products • Air-Handlers

# Your Prize Package!

## Ucon Brand Refrigerants—
## The Compact and Convenient Line
## for All Refrigerant Needs



## Latest Word from Ucon IKE:

**Ucon Brand Refrigerants come in just three popular sizes... and only one type of easy-to-use cylinder per size—a boon to all who like things convenient, effective and uncomplicated!**

**GREAT FOR SERVICEMEN!** Specify Ucon Refrigerants in the 10-lb. and 25-lb. Ring-Top cylinder – the original, handy cylinder that uses its head to make *your* job easier. Carries easier, stores easier, stands inverted by itself while you use it. Ring-Top cylinders have the new convenient handwheel valve that saves time on the job, too. And all Ucon Refrigerants—in 10-lb., 25-lb., or 145-lb. cylinders—are readily available from your wholesaler *when* you need them . . . *as much* as you need. No problem of inadequate inventories of the size you need for the job!

**GREAT FOR WHOLESALERS!** With Ucon Brand Refrigerants, inventory problems are minimized, valuable floor space saved. No need to carry more than the three popular cylinder sizes to satisfy customer request. Record-keeping for cylinder returns is easy, too. For all the refrigerants you need with all the back-up you want, carry Ucon Brand Refrigerants!

**Ucon Refrigerants—the *COMPACT* and *CONVENIENT* Line—for**
**• top quality product • easy-to-use cylinders • friendly personalized service**

Ucon Brand Refrigerants are manufactured by
**UNION CARBIDE CHEMICALS COMPANY—** Division of Union Carbide Corporation
270 Park Avenue, New York 17, N. Y.

Exclusive Sales Agent to Air Conditioning and Refrigeration Wholesalers
**ANSUL CHEMICAL COMPANY,** Marinette, Wisconsin

UNION CARBIDE product Ucon BRAND refrigerants

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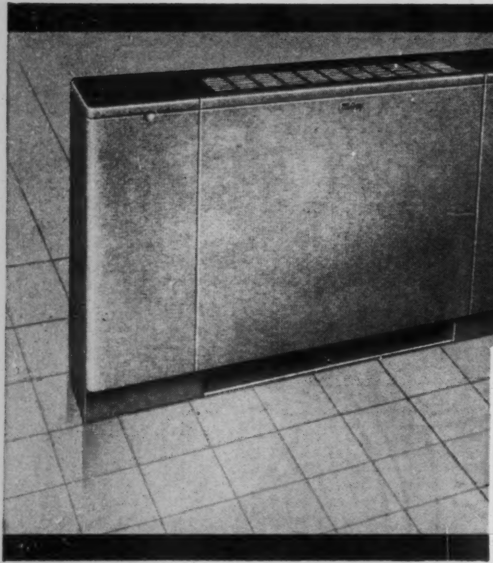
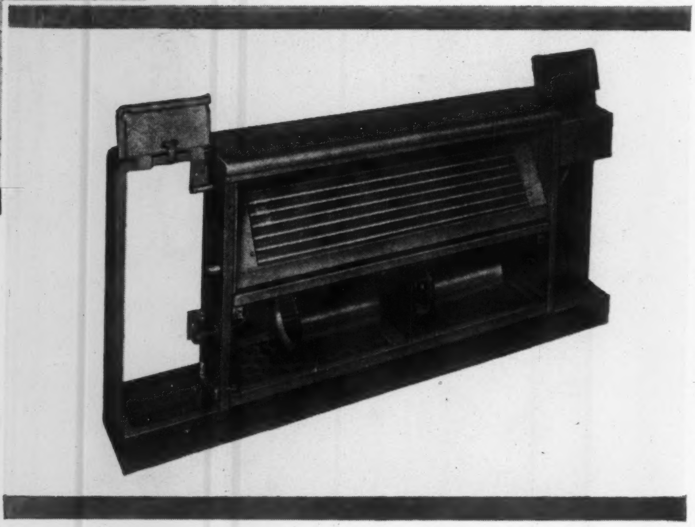
Ucon and Union Carbide are registered trade marks of Union Carbide Corporation



You get more built-in quality and performance with McQuay features

EXTRA LARGE PIPING COMPARTMENTS • COMPLETE SLIDE-OUT FAN DECK ASSEMBLY • MOTOR DISCONNECT PLUG • FIELD REVERSIBLE COILS • FILTER REMOVAL WITHOUT REMOVING PANELS • ADJUSTABLE LEVELING LEGS • REMOVABLE PANELS FOR EASY INSTALLATION • FULL RATED CAPACITY • QUIET, EFFICIENT OPERATION • QUALITY MATERIALS CRAFTED BY QUALITY WORKMANSHIP • BAKED ENAMEL FINISH ON BONDERIZED GALVANIZED STEEL.



# APPRECIATED MOST

*by those who specify, install and use individual room*

# McQUAY *thin-line design* SEASONMAKERS

**NOW**
**4 MODELS**
**7 SIZES**
**220 TO 1240 CFM**

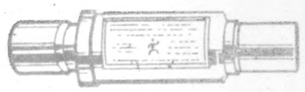
**8½" thin, 25" high**

McQuay thin-line design Seasonmakers are extremely versatile, dependable and exceptionally easy to work with. That's why engineers, contractors and building operators alike appreciate them most. These remote, individual room units are ideal for apartments, motels, hotels, offices, hospitals or any installation utilizing a central station heating and cooling system. They are available in four types in seven sizes. Floor and basic models are made in sizes from 220 to 1240 cfm; hide-away and ceiling models from 220 to 640 cfm.

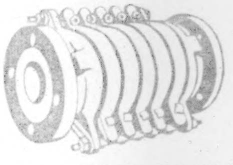
Investigate the many advantages these thin-line design McQuay Seasonmakers can offer you on your next job. Contact your local McQuay representative, or write McQuay, Inc., 1601 Broadway Street N.E., Minneapolis 13, Minnesota.

McQuay INC.
AIR CONDITIONING • HEATING • REFRIGERATION

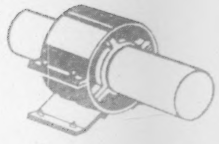
MAKE THE SEASONS COME TO YOU



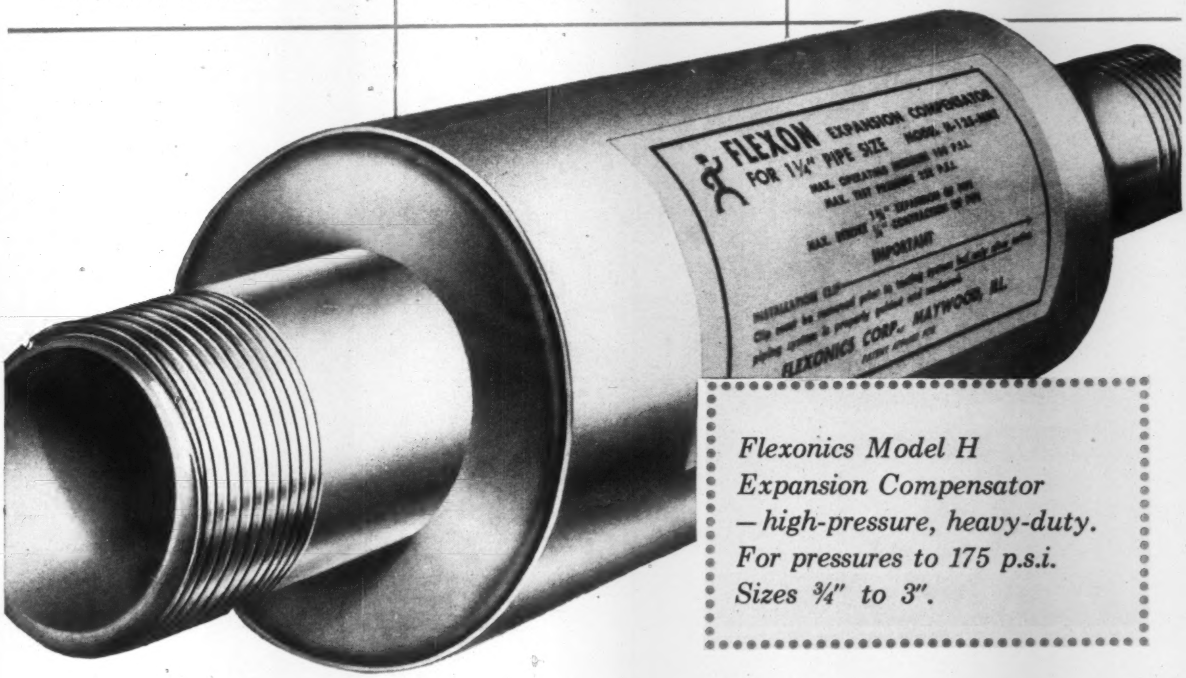
Flexonics Model L Expansion Compensator — to handle pipe and tubing motion up to ½" in low-pressure heating systems.



Flexonics Expansion Joints — controlled-flexing, free-flexing, and many special types, in an unlimited range of sizes.



Flexonics Pipe Guides — a completely new and better way to keep pipe in alignment. Positive, rugged, inexpensive.



*Flexonics Model H Expansion Compensator — high-pressure, heavy-duty. For pressures to 175 p.s.i. Sizes ¾" to 3".*

## INCH FOR INCH, THE LOWEST-COST WAY TO TAKE UP PIPE EXPANSION

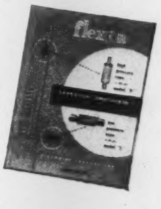
Any way you look at it, the Flexonics Model H Expansion Compensator *costs less* — costs less per inch of stroke than any other way to handle pipe motion — costs less after it's installed because it never needs maintenance.

Yet the Model H is built for hard service. Its 2-ply stainless steel Flexonics bellows is designed to outlast the building. Steel-encased and heliarc welded for full protection from external damage. Positive internal guide and anti-torque device. Completely packless. No servicing necessary after installation.

These are the reasons why engineers and piping contractors are specifying the Flexonics Model H for thousands of industrial piping jobs that use pipe up to 3" and require up to 2" total movement at each Expansion Compensator. Working pressures to 175 p.s.i. for ¾" and 1" sizes; to 125 p.s.i. for larger sizes up to 3".

Make the Flexonics Model H Expansion Compensator a cost-cutting part of your next piping job.

**Today—write for informative and helpful Catalog No. 163R.**



EC-130

**Flexonics**
**corporation**

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ont.

EXPANSION JOINTS · METAL HOSE · SYNTHETIC HOSE · BELLOWS · AERO/SPACE COMPONENTS

SUBSIDIARY OF CALUMET & HECLA, INC.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

**Flexonics Corporation**
**1391 S. Third Avenue**
**Maywood, Illinois**

**Please send me my personal copy of Flexonics Catalog 205, including full information on using Flexonics Expansion Compensators to absorb pipe movement.**

Easily-installed PPG Neoprene-coated Duct Liner now meets fire requirements, provides extra margin of safety on ductwork installations.

# NOW—PPG Fiber Glass Duct Liner Carries the UL Label

## PPG Neoprene-Coated Superfine Duct Liner Meets All Requirements of NBFU Bulletins No. 90-A and 90-B for Ducts

### YOUR ASSURANCE OF SAFETY

PPG is proud to announce that its Neoprene-coated Superfine Fiber Glass Duct Liner has been thoroughly tested according to the condition determined by National Board of Fire Underwriters, and has met the Board's rigid safety requirements in compliance with Bulletins No. 90-A and 90-B for ducts. It now bears the label of the Underwriter's Laboratories, Inc.

For you, this means that PPG Neoprene-coated Fiber Glass Duct Liner meets fire requirements and provides that extra margin of safety on any ductwork installation.

### PLUS ALL THOSE EXTRA PPG ADVANTAGES . . .

. . . such as lightweight, easy handling, easy cutting and piecing, low wastage, fast installation, fine acoustical qualities, good thermal barrier characteristics, low resistance to air flow, no air erosion; and lifetime service, because it won't rot or decay, is not affected by humidity or dryness.

Give PPG Fiber Glass Duct Liner a try. It offers you a combination of top-flight insulation and economy. For full information, call your nearest PPG Fiber Glass Sales Office, or write *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.*

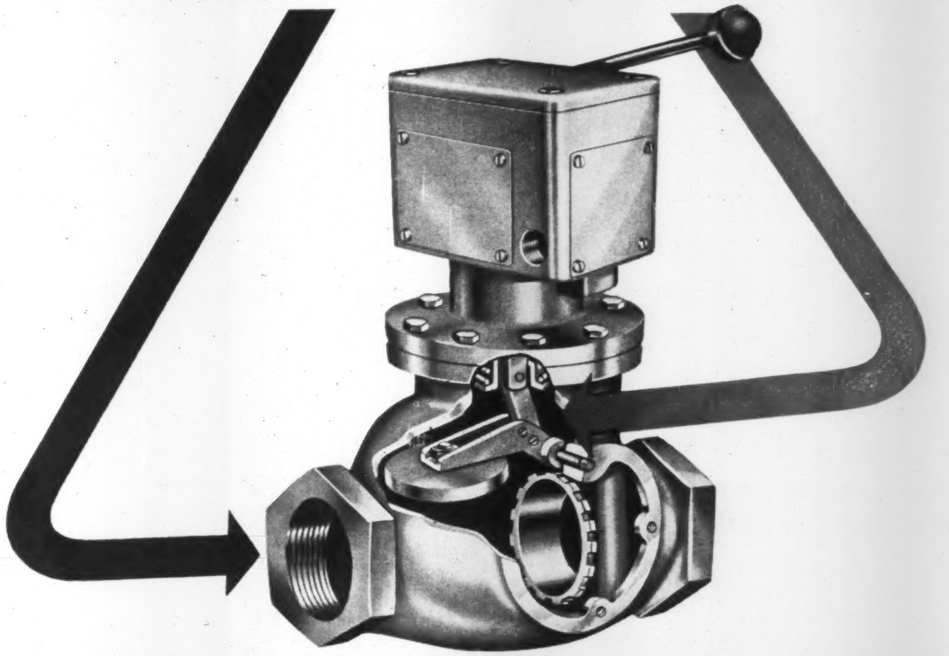
Sales Offices: Atlanta, Attleboro, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Fort Wayne, Houston, Kansas City, Louisville, Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis and Washington.

FIBER PPG GLASS

**PITTSBURGH PLATE GLASS COMPANY**

## *Which of these major gas valve problems is yours?*

# CAPACITY? SAFETY?



### THIS NEW GENERAL CONTROLS HI-FLO GAS VALVE SOLVES BOTH...AND MORE

Straight through flow provides maximum capacity – minimum pressure drop. Vertical seating prevents build-up of foreign matter on valve seat, and soft seat insures positive shutoff. Short 90° travel reset handle for easy opening *and* closing, manually. H-117 model incorporates dual release actuator, and fixed or adjustable opening speeds. Before you buy *any* high capacity gas valve, check this capacity table. You'll find your nearest General Controls factory representative in the yellow pages.

**GENERAL CONTROLS**

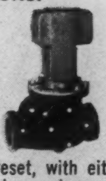
*Automatic Controls for Product or Process*
**Glendale, Calif. • Skokie, Ill. • Guelph, Ontario, Canada**
*Nine plants—44 factory branch offices serving the United States, Canada and Western Europe*

## COMPARE
### THESE GAS CAPACITIES

GAS CAPACITY — 1" DROP

| PIPE SIZE (INCHES) | HI-FLO VALVE | | | CONVENTIONAL GLOBE VALVE |
|---|---|---|---|---|
| | CU. FT. HR. | MAX OPER. PRESS P.S.I. | Cv FACTOR | CU. FT. HR. |
| 1 SCR | 2000 | 50 | 37.8 | 920 |
| 1¼ SCR | 2700 | 50 | 51.0 | 1370 |
| 1½ SCR | 4000 | 50 | 75.6 | 1840 |
| 2 SCR | 8000 | 25 | 151.0 | 3570 |
| 2½ SCR | 12,900 | 15 | 244.0 | 4500 |
| 3 SCR | 17,000 | 15 | 320.0 | 6600 |
| 4 FLG | 27,000 | 8 | 510.0 | 8900 |
| 6 FLG | 54,000 | 5 | 1020.0 | 17,800 |

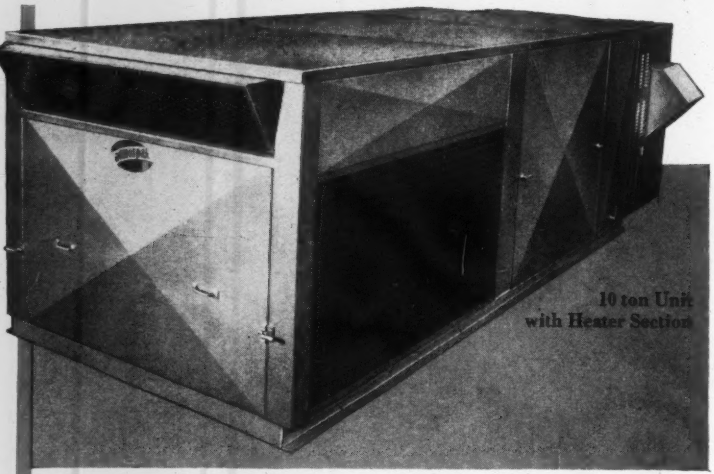
**CHOICE OF TWO ACTUATORS:**



**V-116 MANUAL RESET,** with lever action—90° handle travel. Held open electrically, spring closed on power interruption.

**H-117 HYDRAMOTOR,** electric reset, with either fixed opening speed or adjustable opening speed regulated to design of equipment.

it's time
to take
the credit...



There's always room on top for the original low silhouette.

# ATMOS-PAK

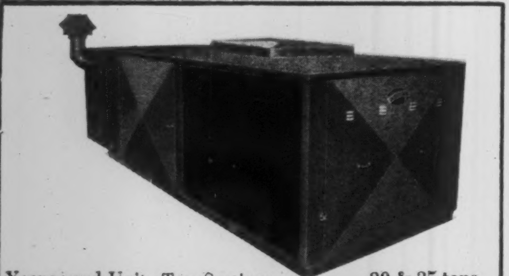
## AIR-COOLED
## ELIMINATES DUCT WORK
## OCCUPIES NO USEABLE SPACE

the atmos-pak ®
Patent No. 2886955

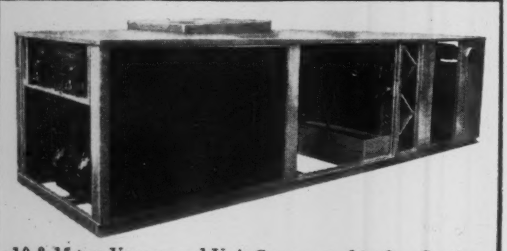
After five years of field development and research, Air Conditioning, Incorporated offers the *original*, pre-fabricated, roof-mounted, year-round air conditioning system in *nine* models of 5 through 35 tons. Our supply and return air ceiling diffuser provides perfection in air distribution and readily adapts to ceiling treatments.

While applicable to existing buildings and varied functional structures, the "Atmos-Pak" is primarily designed for the flat-roofed, one story building. This "packaged" system comes in one section for both heating and cooling in the 5 through 20 ton models; in two sections—cooling and heating—for the larger units. Simple connections to electrical power, to oil or gas supply, and low voltage wiring from the thermostat to a terminal block in the unit, result in complete installation.

Over ~~400~~ 500 systems now in operation throughout the east and midwest testify to our rapid acceptance and most thoroughly proven performance. We will be glad to send you our latest bulletin and specification literature on request.



Year-round Unit, Two Sections 30 & 35 tons



10 & 15 ton Year-round Unit Constructed in One Section

designed, manufactured, and pioneered by
**AIR CONDITIONING, INC.**
88 North Highland Avenue
Ossining, New York

We follow here each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

# "Open for Discussion"

## July HPAC Engineering Data File Skips Spring-Actuated Check Valves

IN THE July HPAC Engineering Date File, *What to Consider When Selecting Check Valves, Valve Operators and Accessories,* mention of spring-actuated check valves was inadvertently omitted from our discussion. The spring-actuated check valve is basically a lift check valve in design, but a spring is installed to speed closing. The principal differences in performance come about through the addition of the spring. These differences are as follows:

1) Valve closure is accelerated by the spring. Quick closing, as illustrated in the Data File, is required in many services to eliminate water hammer and, therefore, noise and shock that accompany it.

If a conventional slow-closing check valve without a spring is used in a liquid line, the reversal of flow has time to build up a high enough velocity to result in water hammer and shock.

When a change in the direction of the flow in a line occurs, it is obvious that the flow will momentarily cease. Spring-actuated check valves are so designed that they will close before the flow reversal has started. As a result, there is no shock caused by water hammer in a liquid line.

2) The spring also damps energy changes in pulsating flow, thereby minimizing chatter when such conditions exist.

3) The pressure drop for a spring-actuated valve is slightly greater than that of an otherwise identical lift check valve. This is due to the energy required to load the spring when the valve is in the open position. Both of these types have higher pressure drop than the swing check valve, due to the difference in the flow paths through the valves. The flow must make several turns in any lift check valve, but flows straight through the swing check valve.

Spring-actuated valves are available in a variety of materials to meet the temperature, pressure, and corrosive conditions of many piping services. When specifying a spring-actuated valve it should be stated whether the valve is to be used in a horizontal or vertical line. If it is to be used in a vertical line, the direction of flow should be stated.

Spring-actuated check valves are available for use in horizontal, vertical, or angular lines. For downward flow in a vertical line, suppliers recommend a vertical spring-actuated check valve in the upside down position.

CARL A. DOPP

## Brine Systems' Advantages Proved In Auto Fuel Test Lab Installation

THE SYSTEM described in the article, *Brine System Maintains Artificial Weather in Auto Fuel Lab,* by Paul London (August), represents an excellent example of the advantages of using brine in certain automotive test operations.

The data presented by Mr. London in his excellent treatment of the subject suggests that it may be possible to make wider use of refrigerated brine in industrial operations than has generally been supposed. It appears that in some cases the first cost as compared to direct expansion cooling may not be out of line and that the operating advantages of ethylene glycol brine would offset higher installation costs.

# "Open for Discussion"

Continued

A careful study of all factors having an influence on both first cost and operating costs on a contemplated installation should indicate the type of cooling cycle best suited to the operating requirements.

Some things that prevent economical performance of secondary refrigerating systems, both in low temperature work and in higher temperature operations, are improper installation of all or a part of brine systems. I have observed several examples of improper installation in recent years. Some of these are:

1) Brine pump selected was not suited to the conditions of operation.

2) Pump was supported on unstable foundation.

3) Brine piping system was not correctly supported.

4) Neglect of proper maintenance to brine mains and laterals, particularly the pipe insulation.

By using brine coolers designed to insure optimum brine velocity and rapid removal of refrigerant gases as formed, including flash gas, excellent cooling efficiency is possible. This is particularly true where the brine cooler can be operated flooded under automatic liquid feed control or supplied by a liquid refrigerant pump.

As a general rule, of course, the overall first cost of a brine system of refrigeration, either for general service or for special applications, is higher than would be true of a direct expansion system. Yet, for certain applications, such as pointed out by Mr. London, the brine system is superior.

C. T. Baker
*Consulting Engineer*

## Efficiency, Economics Pave Way To Heat Pumps' "Bright Future"

I think the article, "*Heat Pumps Have a Bright Future,*" (July) is well worthwhile. Robert Morse Wood has taken a good look into the future. His observations so parallel my own opinions of the heat pump and its future utility value that I am reluctant to say anything other than "well done."

As internal loads increase, such as created by more intense lighting, the outdoor temperatures at which the system must convert from cooling to heating become lower. This is quite favorable for the heat pump — particularly the air-to-air unit. The old adage that "so much" must be added to a heating plant to make it a year 'round system may be in for a change. Isn't it reasonable to visualize our systems being designed for summer cooling, if by merely a few minor changes we can convert them to year 'round operation? Such changes may be much less than changing a heating system to provide for cooling.

The continuous operation of the heat pump will certainly be an important factor in increasing its economic desirability. The cost of "winterizing" the cooling system and "summerizing" the heating system will be no more. A well-designed system is frequently better off operating than standing idle. Perhaps the continuous operation aspect of the heat pump will result in less replacement of equipment. Certainly we can anticipate less overall maintenance cost.

William T. Smith
*Chief*
*Air Conditioning & Refrigeration Section*
*U. S. Air Force*

## Wants More Details on Design Of Diesel Engine Testing Cells

H. W. Schiewe's interesting article, "*Spot-Cooling" System Ventilates New Diesel Engine Testing Plant* (July), is a manifestation of the old saying "there are many ways to skin a cat."

The May issue described a ventilating system recently installed for handling a somewhat similar condition using an entirely different solution than described by Mr. Schiewe. This article, *Ultra-Modern Engine Plant Demands Unique Heating, Ventilating Systems,* concluded that results of the system were quite satisfactory, too.

Mr. Schiewe does not state what portion of the 150,000 sq ft of the Cummins Engine Co. building is devoted to the test cells. Also, what portion, if any, is used for other purposes?

The system was designed to provide good working conditions for employees and to supply satisfactory conditions for efficient testing operations. Good working conditions for diesel engine testing were defined as: (1) good ventilation for operating personnel, (2) maximum escape of heat from the engine under test, (3) reduction of noise, (4) having work areas unobstructed, and (5) means of moving test engines through the test procedure.

Brief comment is made on items (2) through (5), indicating that, in each case, the objective had been achieved. A question arises as to whether the direct discharge of engine exhaust through roof mounted mufflers without dilution or cleansing could pose smoke or community air pollution problems.

Ventilation of test cells received the most attention and some of the design detail is given. Omission of the size of the test cell and their arrangement leaves the reader unable to visualize the relation of the test operator to the adjustable supply outlets described. The velocity of 2500 fpm of the supply at "close proximity to the testing engineer" seems excessive, even for relatively short periods. Also, with this velocity discharging from four outlets, considerable induced draft would be generated in areas adjacent to the test cells.

It would be interesting to know the relationship of the "outlet grille in the ceiling [of the test chamber] which allows the air which has been heated by the operating engine to escape" and "each cell is further provided with a ceiling exhaust fan which withdraws the heated air and discharges it outdoors." No mention is made of the possible use of all this discharged heat.

I believe it would be of considerable interest to know the degree of success achieved with this installation during the warm summer months.

LESTER S. RIES
*Consulting Engineer*

THE AUTHOR'S REPLY — My article did stress mostly the test cell ventilation aspect of the work. This was done because it would have been impractical to go into the many and varied phases of the work.

Mr. Ries has posed some questions which require additional information. These I will attempt to answer in the following paragraphs.

The engine test cells generally measure 11 ft wide × 14 ft deep. Of the total of 150,000 sq ft of main floor area, 42,000 sq ft is devoted to housing these cells. The photographs and diagrams which accompany the article show the engine working space, the air supply outlets, and the air exhaust outlet. These have undoubtedly cleared up the question as to the relationship of the test operator to the air supply and exhaust facilities.

The air velocity of 2500 fpm discharging in close proximity to the testing engineer has been acceptable in use. Whatever induced air currents are created by this jet velocity have not been objectionable to the testing engineers. That such velocities are not excessive has been proved in countless numbers of marine installations.

Each air supply nozzle is a ball socket joint for directional adjustments and is provided with a built-in deflector. These nozzles can be diverted or adjusted so that the air stream can be directed in almost any direction that an operator might desire.

Each cell has a balanced quantity of air supply and exhaust. The operation of one cell does not affect adjacent areas, nor does the 2500 fpm air velocity employed create induced drafts in adjacent areas.

The use of discharged waste heat was thoroughly analyzed and discussed during the preliminary stages of design. The results of these studies are summarized as follows:

1) Waste heat is not produced during vacation periods, week-end shutdowns, etc. For these periods we must provide adequate heat for ventilation and space heating from a central source. As long as we must provide this heating facility, no economy of initial cost can be realized by counting on waste heat generated.

2) After the first few hours of operation, the problem we face is the removal of heat. This waste heat cannot be rejected into the test cell area where its over-abundance is the problem.

3) Other areas in the building that might benefit by the use of this heat pose the same problem as stated under (1). When they require heat, heat may not be available from the testing operations; so a basic system of supplying heat for ventilation and space heating must be provided in these areas also. This again allows no economy in initial cost.

4) If this waste heat were to be salvaged and transported to areas that could make use of it, we would benefit by the savings in fuel that is normally used to serve these spaces. However, such areas are in most cases distant from the source of waste heat. The cost of installing equipment to transport the heat from test cell areas to spaces where it might be used was found to be prohibitive when compared to the savings in fuel to be expected.

5) To sum up the studies, it was determined that it was not economically sound to transport an unknown quanity of heat for unknown periods of time to areas that for the major portion of any year would not require the heat.

Direct discharge of engine exhaust through roof mounted mufflers without dilution or cleansing proves no problem to the adjoining community or to the plant itself.

At this writing, the installation continues to be a success, even though we are nearing the end of a summer which has provided us with some of the problem days we designed against.

H. W. SCHIEWE
*Mechanical Engineer*
*Samuel R. Lewis and Associates*
*Consulting Engineers*

## Always Provide Means to Control Variable Subatmospheric Pressures

THE ARTICLE, *Vacuum Steam + Outdoor Reset = Simple, Reliable Heating Control*, by Anton Krapek (July), on the use of subatmospheric steam for heating school houses is most pleasing to us. We have been promoting this idea for over 30 years. In fact, the original and basic patent covering this method of control was issued to C. A. Dunham in 1928. Since the expiration of this patent, other manufacturers have entered the field. In all these years, thousands of these systems have been installed, first under the trade name of "Differential" system and, more recently, "Vari-Vac." Many of the installations have been in schools, often without any other auxiliary control, such as room thermostats.

We wish to comment on one point in the article. Mr. Krapek speaks of a maximum vacuum of 20 in.

## "Open for Discussion"

Continued

Hg. Our systems habitually operate at up to 25 in. (steam temperature 133 F). It will be seen that this increases the control range by 50 percent (218 − 133 or 85 F, compared with 218 − 161 or 57 F). This extra 5 in. of vacuum is therefore important and is easily obtainable with our vacuum pumps.

There is another factor the author doesn't mention, and that is the improved performance of the radiation and the unit ventilators. When radiation of any kind is used in schools today it is usually in the form of finned pipe installed under windows to counteract cold drafts. It is used either as a supplement to unit ventilators or as the sole means of heating. Steam is usually maintained at a constant 1 to 2 psi at the radiator valve and, if a vacuum pump is used, the pump controller is set for 3 to 8 in. Hg in the returns.

The heating effect of the radiation is adjusted by throttling the steam flow. This means that, except in the most severe weather, the radiation is only partially filled with steam and the end toward the trap is cold, defeating the purpose of providing a blanket of warm air over the windows. This takes place at all outdoor temperatures above the design base. Double tiering is one cure, but it is an expensive one.

With subatmospheric steam the radiation remains full of steam down to the trap until such mild weather is reached (around 50 F) that partial filling is no longer objectionable.

The same effect takes place in the unit ventilators, although not to such a marked extent, due to the use of distributing tubes in the coils. However, tests we conducted several years ago with one of the unit ventilator manufacturers showed a marked improvement in the uniformity of outlet air temperatures and less need for a "leakstat" or similar device to prevent blowing cold air into the room.

The test results reported by Mr. Krapek showing savings averaging over 20 percent confirm what we have always claimed and make it clear that whenever steam is used for heating, means for controlling the circulation at variable subatmospheric pressures should always be included, regardless of what other form of temperature control is used.

Lewis Smith
*Dunham-Bush, Inc.*

The author's reply — While it is quite true that this particular principle has been in use for a number of years, to our knowledge the Gier Park School project was the first to employ the vacuum outdoor reset control in conjunction with unit ventilators. At least this is the case in regard to the particular manufacturer that supplied the equipment.

It is true that the system will operate as well with 25 in. Hg vacuum. However, here we followed one manufacturer's recommendations in our design procedures. His maximum vacuum was 20 in. Hg and, since this project was a "first," we didn't feel that we should increase these conditions. All of our projects have been operating to the satisfaction of all concerned. No doubt other manufacturers use vacuum pumps at 25, 20, or even 15 in. Hg.

With the use of this system, the close pressure differential provides constant filling of heating elements, regardless of location. Sporatic heating effects are thus eliminated. The major amount of controlling is done within the mains themselves and only a slight amount of duty is left for the space controls. Operation is such that the space controls can modulate within their normal range, eliminating the possibility of override.

In the case of unit ventilators, it is quite apparent that more uniform discharge temperatures are maintained. Just as important, however, is the fact that control hunting is greatly deterred. Since unit ventilators are required to provide both heating and ventilation, they are particularly victimized by the effects of excessive heating capacity because they are most often controlled by air stream stats in addition to room thermostats. Without outdoor control the ventilator discharge temperatures fluctuate and cause over and underriding of room temperatures, with the need of longer cooling cycles.

During mild weather operation, after space temperatures have been satisfied, the valve controlling the steam delivery to the coil is throttled. Discharge air temperature drops quickly, the air stream stat becomes active and gains control from the space thermostat even though the space is satisfied. The coil valve opens and completely fills the coil with dense, hot steam. Overheating begins to occur and the space thermostat again gains control, closing the valve and increasing the amount of outdoor air beyond the amount required for normal ventilation in an effort to dissipate the undesired heat.

When the discharge air temperature again drops, the air stream stat again seizes control, causing the outside air damper to close and the coil valve to open as before. This cycling not only causes wide variations in discharge air temperatures, but also wastes heat and fuel.

The results are not the fault of the unit ventilators or their controls. Rather, they are due to the lack of outdoor control to regulate the unit heating capacity to correspond with outdoor temperatures.

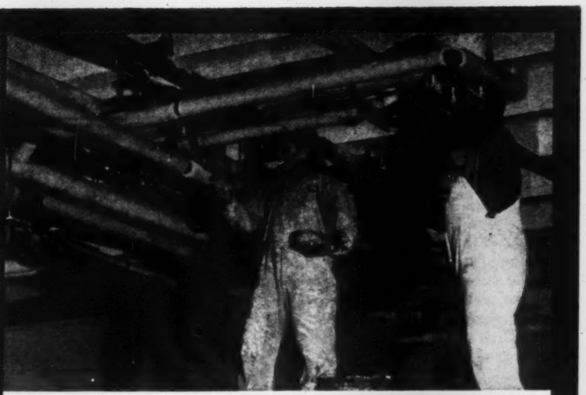
Anton Krapek
*Vice President*
*E. Roger Hewitt Associates, Inc.*
*Professional Engineers*

# update your "specs"

ON

## G-B GLASS FIBER INSULATIONS

Technical bulletins on the Gustin-Bacon glass fiber insulations shown here, including complete specifications, have been revised and reprinted from time to time. To be sure your literature file is up-to-date, simply fill in the coupon below, check the information you need, and mail.



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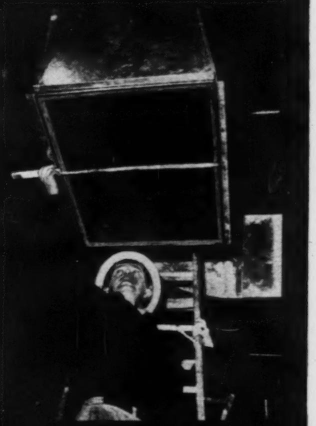

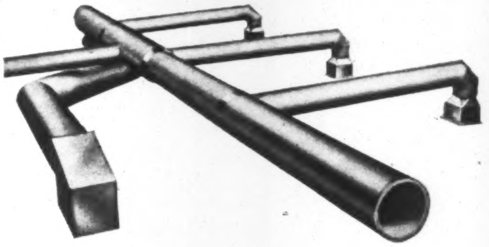

### new "prefab" glass fiber duct — G-B DUCT

G-B DUCT — the round, prefabricated duct made entirely of glass fiber insulation — absorbs cross-talk noises usually associated with air conditioning systems in motels, medical centers, retail stores, etc. G-B DUCT is high in thermal efficiency, too! Just check **G-B DUCT Brochure** in coupon at right for further information.

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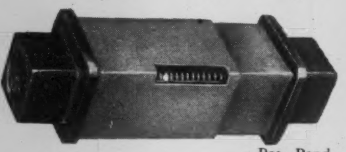
### USED WITH CONVECTOR AND FIN TUBE BASEBOARD RADIATION UNITS IN SCHOOLS, HOSPITALS, OFFICES AND COMMERCIAL INSTALLATIONS

TYPE 7 Q square brass telescoping case protects laminated stainless steel bellows from torsion, squirm, misalignment and external damage. Compensators are used in high and low pressure hot water supply lines, risers and for baseboard radiation. Extra flexibility provides maximum cyclic life. Units are very compact and rugged. Sizes ¾″ thru 3″. Pressures to 300 PSI. Temperatures to 800°F. Traverse: Single Units, total 2″ (1-½″ compression, ½″ extension) Dual units available.

TYPE 11 Q-T has heavy square telescoping case and laminated stainless steel bellows. For use in risers and with baseboard radiation. Test pressure 150 PSI, working pressure 100 PSI, temperatures to 300°F. Traverse: Total 1″ (¾″ compression, ¼″ extension).

### TYPE 7 Q WITH BRASS FEMALE THREADED ENDS

Working Pres. 300 PSI Maximum
Temp. 800 F

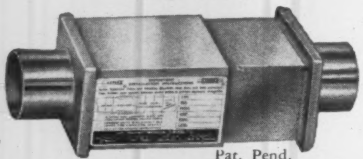


Pat. Pend.

| Nom. I.P.S. | Overall Length | Max. O.D. | Wt. # |
|---|---|---|---|
| ¾″-1.00″-1.25″ | 6.50″ | 2.00″ | 2 |
| 1.50 | 6.50 | 2.50 | 4 |
| 2.00 | 6.50 | 3.00 | 5 |
| 2.50 | 6.50 | 3.50 | 6 |
| 3.00 | 6.50 | 4.00 | 9 |

### TYPE 7 Q-T WITH COPPER TUBE ENDS

Maximum Pres. 200 PSI Maximum
Temp. 300 F

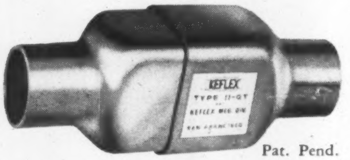


Pat. Pend.

| To Fit Copper Tubing | | Overall Length | Max. O.D. | Wt. # |
|---|---|---|---|---|
| Nominal I.D. | Actual O.D. | | | |
| ¾″ | ⅞″ | 6.50″ | 2.00″ | 1½ |
| 1 | 1⅛ | 6.50 | 2.00 | 1½ |
| 1¼ | 1⅜ | 6.50 | 2.00 | 1½ |
| 1½ | 1⅝ | 9.00 | 2.50 | 3½ |
| 2 | 2⅛ | 10.00 | 3.00 | 4½ |
| 2½ | 2⅝ | 10.75 | 3.50 | 5½ |
| 3 | 3⅛ | 11.50 | 4.00 | 8¼ |

### TYPE 11 Q-T WITH COPPER TUBE ENDS

Maximum Pres. 100 PSI Maximum
Temp. 300 F



Pat. Pend.

| To Fit Copper Tubing | | Overall Length | Max. O.D. | Wt. # |
|---|---|---|---|---|
| Normal I.D. | Actual O.D. | | | |
| ¾″ | ⅞″ | 4.50″ | 1.50″ | 1¼ |
| 1 | 1⅛ | 4.50 | 1.50 | 1¼ |
| 1¼ | 1⅜ | 4.50 | 1.75 | 1½ |
| 1½ | 1⅝ | 4.50 | 2.25 | 3 |
| 2 | 2⅛ | 4.50 | 2.75 | 4 |

## EXPANSION JOINTS—VIBRATION ABSORBERS—FLEXIBLE CONNECTORS—PIPE GUIDES
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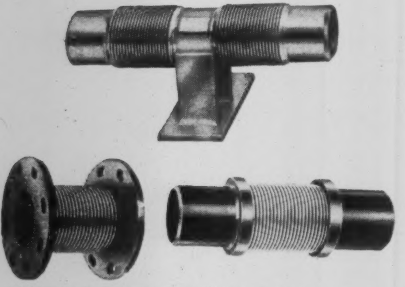
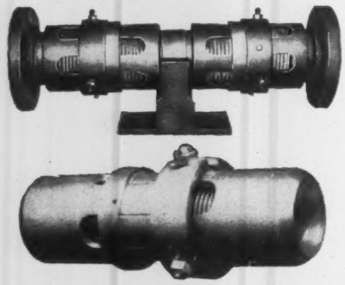
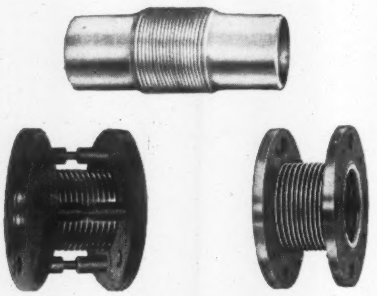


**KEFLEX EXPANSION JOINTS** — corrugated, packless type for steam and hot water heating systems and process piping. Laminated stainless steel bellows with internal liner guides and stainless steel contour control rings. Weld ends, or flanges. Outside shrouds and intermediate anchor bases available. Sizes 2″ through 48″. Pressures 70 to 450 PSI. Temperatures to 800° F. Furnished for various required traverses.



**KEFLEX-KETROL CONTROLLED EXPANSION JOINTS** — positive protection against torsion. For use in pipe lines to compensate for expansion and contraction. Shroud has intermeshing fingers providing concentric guiding and protection against squirm, torsion, and external damage to laminated stainless steel bellows. Designed for high pressure, high temperature hot water service. Movement is controlled by limit stops. Sizes 2″ through 48″. Pressures to 450 PSI and temperatures to 800° F.

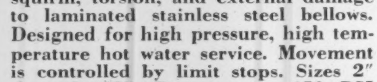


**KEFLEX FLEXIBLE CONNECTORS AND VIBRATION ABSORBERS** — to absorb vibration from pumps, chillers, and compressors. Serves to relieve stress on pump volute when piping is misaligned. Extra flexibility of laminated stainless steel construction produces long cyclic life. Compact units save space and are easy to install. Available with or without tie rods. Sizes 2″ through 48″. Pressures to 450 PSI and temperatures to 800° F.

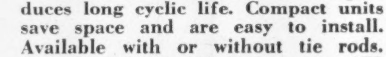
Modified Types are available for special conditions requiring higher pressure, temperatures, traverse, or combination deflections.

**KEFLEX-MAVE TYPE M**

Fabricated steel pipe guides for concentric guiding of pipe lines. Special insulated guides are available for chilled water.



**FLEXIBLE "BMH" CONNECTORS**



**"USF" BRONZE VIBRATION ABSORBERS**

Braided bronze Metal Hose assemblies made in standard lengths. Usually used as flexible connectors on pumps and other mechanical equipment for heating and air conditioning service. Available with threaded male ends, flanges, and copper tube sweat ends.

# question of the month

## "How Much Load from Vapor Infiltration"

**"My problem is primarily concerned with moisture vapor infiltration and/or transmission through cracks and door openings. Our operations include research with hazardous, explosive materials and must be conducted in an atmosphere of low moisture content (about 20 grains per lb of dry air). Due to their character, these materials must be isolated in small cells having one light or frangible wall and roof for explosion relief.**

**"Recirculation is prohibited, due to the same hazards. Therefore it is desirable to keep the number of air changes to a minimum for the sake of economy. Exhaust fans and hoods are utilized which remove approximately 90 percent of the supply air. The doors, which are the only means of access, are located in the relief wall and constitute about 16 percent of the perimeter of the cell walls.**

**"My question is in two parts: (1) How much latent and sensible load should be included per ft of crack and per door opening with outside design of 100 F dry bulb, 81 F wet bulb, and with 15 mph wind? (2) Can the water vapor infiltration through the cracks be prevented by a positive air pressure within the space?**

**"It seems entirely possible, with the nearly 10 in. of water gage difference in vapor pressure between the outside and inside, that water vapor might be coming in while air could be traveling in the same direction along the same path.**

**"I would also appreciate knowing of any good reference material concerning the above problem, as well as the fundamentals and behavior of the mixing of gases, partial pressures, and vapor pressures."—M.B.M.**

### Positive Air Displacement Stops Air Infiltration into Building

First, M.B.M. wants to estimate the latent and sensible load per foot of crack and door opening. I believe the following approach is precise enough to meet his need.

It involves some shortcuts to reduce the extent of calculations. The following steps are to be followed:

1) Find the pressure differential between the inside and outside of the building.

2) Determine the crack area and door area in square feet.

3) Assume a coefficient of entry $C_e$ across door cracks (a safe estimate is 0.6).

4) Calculate $Q$, flow in cfm, through the crack opening area from the formula **:

$Q = 4005\ C_e\ A\sqrt{SP}$

$C_e$ = coefficient of entry (assume 0.6)

$A$ = area open, sq ft

$SP$ = pressure differential between inside and outside, in. WG.

5) From the psychrometric chart, determine the grains of moisture per pound of air.

6) From (4) and (5), calculate the number of pounds of moisture per foot of crack per minute. This is the latent load. From the inside design temperature and the outdoor temperature, determine the sensible load.

The following example will demonstrate the use of this procedure. Assume a wind velocity of 15 mph, negligible pressure difference between inside and outside; with excess exhaust, a negative pressure will exist; with excess supply, a positive pressure will exist*, outside design temperatures of 100 F dry bulb and 81 F wet bulb, and a measured door crack of 3/16 in.

(Where a crack cannot be measured, assume 3/32 in. for a tight door and 3/16 in. crack for a loose fitting door*. Door area = 3 ft × 7 ft).

Now, follow the six steps:

1) 15 mph wind = (15 × 5280)/60 = 1320 fpm
$VP$ (velocity pressure) = 0.109 in. WG**
Assume $VP$ is converted into static pressure ($SP$)
$SP$ (pressure differential) = wind pressure + building pressure differential = 0.109 + 0 = 0.109 in. WG

2) Crack area = 3/16 × 1/12 × 1 = 0.0156 sq ft per ft crack
Ft of crack = 3 + 3 + 7 + 7 = 20 ft
Total door crack area = 20 × 0.0156
A = 0.312 sq ft

3) Use 0.6 = $C_e$ (coefficient of entry)

4)
$$Q = 4005\ C_e\ A\sqrt{SP}$$
$$Q = 4005 \times 0.6 \times 0.312\sqrt{0.109}$$
$$Q = 4005 \times 0.6 \times 0.312 \times 0.33$$
$$Q = 248 \text{ cfm flow through door crack}$$

5) From the psychrometric chart, 130 grains per lb air
Density factor (460 + 70)/(460 + 100) = 0.945

## question of the month

*Continued*

Density 0.075 × 0.945 = 0.071 lb per cu ft
248 cfm × 0.071 = 17.6 lb of air
17.6 × 130 = 2290 grains of moisture through door crack per min.

6) *Latent load:*
17.6 × 130 = 2290 grains per min per total door crack

*Sensible load:*
Assume indoor design temperature 70 F, (100 − 70) × 0.075 × 0.24 = 0.54 Btu per min per cu ft
248 × 0.54 = 134 Btu per min through door crack
Assume 0.24 = specific heat of air
0.54 × 60 = 32.4 Btu per hr per cu ft
32.4 × 248 = 8040 Btu per hr through door crack

In answer to M.B.M.'s second question, water vapor infiltration can be prevented by a positive air displacement in the building. Pressure in the building must be greater than wind pressure. Air flow through cracks must be outward. For example, in the above problem, total pressure differential is 0.109 in. water gage. Inside pressure must be in excess of this. I would recommend 0.15 in. to 0.20 in WG — depending on factor of safety desired.

**When and Where is Makeup Air Necessary,* by G. M. Hama, Air Conditioning, Heating and Ventilating, November 1959.

***Industrial Ventilation, a Manual of Recommended Practice,* American Conference of Governmental Industrial Hygienists, Sixth edition, 1960.

GEORGE M. HAMA
*Senior Associate Industrial Hygienist*
*Bureau of Industrial Hygiene*
*Dept. of Health*
*City of Detroit*

### Moisture Movement Doesn't Always Follow Path of Air Stream

MOVEMENT of moisture results from diffusion of vapor into or from a gas. Ordinary diffusion is caused by a concentration gradient. Pressure diffusion is due to a hydrostatic pressure difference and thermal diffusion results from a temperature gradient. Usually, a temperature gradient causes a pressure gradient.

Mass transfer attendant with humidification and dehumidification depends on movement of material in thin films. A boundary layer on a thin film adjacent to the surface, limits movement of the mass.

The transfer results from displacement of the fluid due to convection and also by molecular or eddy diffusion. Transfer through a film is primarily by molecular diffusion; whereas movement in the main body results from fluid convection. These actions may take place simultaneously.

Rate of transfer is a function of the diffusivity and concentration gradient. Variations of the latter cause potential forces which tend to equalize.

Diffusion rate may be calculated by Fick's law, which is:

$$N_v = [D_{va}\,(P_{v1} - P_{v2})]/RTL$$

*where:*

$N_v$ = diffusion rate of vapor in air, lb moles per sq ft per hr
$D_{va}$ = diffusion coefficient, sq ft per hr
$P_{v1}, P_{v2}$ = vapor partial pressure, atmospheres
$R$ = universal gas constant, cu ft (atm per lb mole per T.
$T$ = absolute temperature, R
$L$ = Length of diffusion path, ft
${}_{v,\ a}$ = vapor and air, respectively.

The negative sign indicates diffusion occurring in a direction opposite that of increasing concentration.

For the conditions described by M.B.M., the value of $D$ for water vapor diffusing in air may be taken as 0.992 sq ft per hr.

These relations are analogous to Fourier's equation for steady-state heat flow. This equation expresses partial pressure change as a function of distance, for an air-vapor mixture. The sum of the partial pressures of the vapor and air is constant at any location in the diffusion path.

For an unsteady diffusion rate wherein the vapor or gas concentration changes with respect to time, the relations are:

$$N_v = -D_{va}\,(dC_v/dL)$$

*where:*

$C_v$ = vapor concentration, lb moles per cu ft
$(dC_v/dL)$ = concentration gradient for vapor in $L$ direction.

Knowing inside dry bulb and wet bulb temperatures, M.B.M. can estimate the vapor pressure and specific humidity. Substituting these values in the above equations will permit calculating the vapor transmission rate and attendant sensible and latent heat transfer rates.

M.B.M. mentions existence of a pressure differential of approximately 10 in. WG resulting from the exhaust fans and hoods. Rate of flow across a crack varies directly with magnitude of pressure difference across the crack and inversely with resistance against the pressure difference.

Maintaining a positive pressure inside the room, will prevent inward air flow. However, it will be necessary to condition the makeup air before it is discharged into the room. This involves sensible and latent heat removal by cooling and dehumidification.

The subjects of vapor-gas mixing and partial pressure relations are discussed in most thermodynamic texts. The following are suggested:

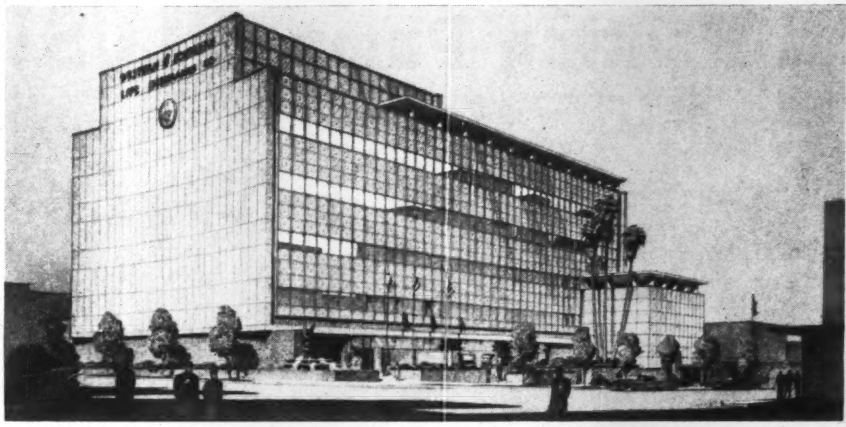
*Thermodynamics,* by E. F. Obert. McGraw Hill Book Co., Inc. *Chemical Process Principles — Thermodynamics, Part II,* by Hougen and Watson. John Wiley & Sons.

Mass transfer including diffusion is well treated in the following:

*Elements of Heat Transfer* — Chapter XVI, by Jacob and Hawkins. John Wiley & Sons.

*Chemical Process Principles — Kinetics and Catalysis,* Part III, by Hougen and Watson. John Wiley & Sons.

H. B. WAYNE
*Consulting Engineer*



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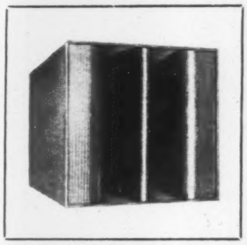

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TOP SIX STORIES of this Oklahoma City office building were added to existing structure. Heat pump reclaim system, which supplies year 'round heating and cooling to building addition, is major development

*Through two years' successful operation in this building . . .*

# Heat Pump Reclaim System Proves New Design Approach

By NEIL HILL
Design Engineer and Partner
Sorey, Hill & Sorey
Architects and Engineers

RECENT YEARS have seen remarkable strides in the use of the heat pump in multi-story office buildings. Significant among these developments is the heat pump system serving a six-story addition to the home office of the Oklahoma Gas and Electric Co., Oklahoma City. This system, which has passed through two winters with flying colors, was actually simpler to install and is easier to operate than a conventional system using a refrigeration machine for cooling and a boiler for heating.

The heat pump system (let's call it *heat pump reclaim cycle*) is composed of a centrifugal refrigeration machine, along with standard equipment that is normally found in a multi-story office building. This building sustains itself on the heat that is inherent within a compact office building without reaching out for an outside source of heat to artificially load the refrigeration machine.

A brief discussion of the conventional heat pump should precede further description of the heat pump reclaim cycle. The cycle is illustrated in Figs. 1 and 2.

Fig. 1 shows the function of the heat pump during the summer or cooling cycle. As you can see, heat is drawn from the building into the chiller, transferred by the compressor from the chiller to the condenser. When the condenser is reached, the temperature level is then high enough to allow the heat to be rejected from the system into the atmosphere. Essentially, the building is the heat sink and we are heating the atmosphere.

Fig. 2 illustrates the heat pump during the winter or heat-

● **Two winters' successful operation, in one instance bucking temperatures as low as −7 F, attest to the excellent design of the heat pump system serving this Oklahoma City office building addition. The system, a mark of simplicity in engineering design, provides year 'round comfort to occupants via the heat pump reclaim cycle. This article explains the engineering reasoning behind the design and how all the factors were considered—including weather statistics, load variations, control and ventilation requirements, and the economy of using the reclaim cycle.**

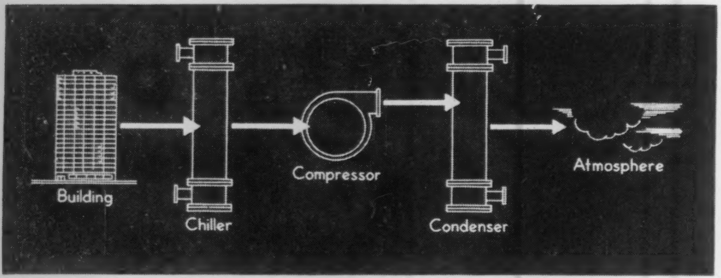
**Mr. Hill graduated from Oklahoma State University in 1952 with a degree in architectural engineering, specializing in mechanical engineering. He has been active in the design of air conditioning systems for a wide variety of applications in the Southwest. A partner in the firm of Sorey, Hill & Sorey, he is a licensed professional engineer in Oklahoma and Texas and a member of several engineering societies.**

ing cycle. Heat is drawn out of a heat sink into the chiller, moved from the chiller to the condenser by the compressor where again it has been lifted to a high enough temperature level to flow into the building for heating.

Actually, the heating cycle is nothing more than the application of an artificial cooling load to the refrigeration machine. The heat taken from this artificial load is then added to the heat of compression and the total is rejected to the building for heating.

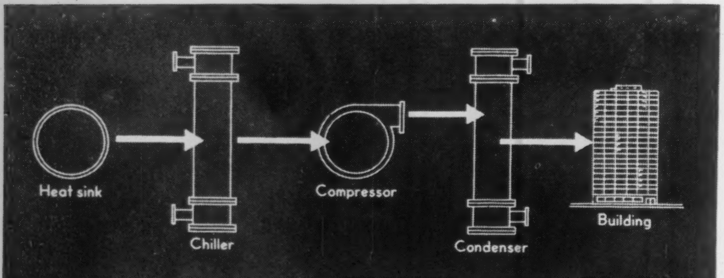
In conventional heat pump systems the refrigeration machine is loaded by various outside sources. One popular method is to drill two water wells into different strata and depths. Water is drawn out of one well during the winter cycle, moved through the evaporator where heat is extracted, then returned to the earth via the other well. In the summer cycle this flow is reversed, and the water is sent through the condenser where heat is rejected and returned to the bottom of the first well. Operation of such systems has been reasonably successful.

Another popular method is the use of outside air as a heat source. On winter cycle the evaporator extracts heat from the outside air



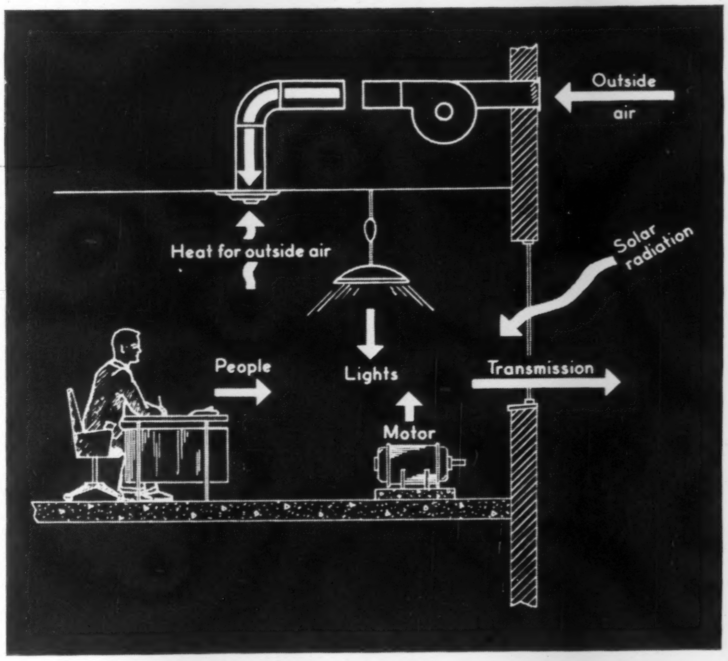
**COOLING**

**1** IN SUMMER, heat is drawn from building into chiller, is transferred by compressor to condenser. At condenser, heat is rejected from system into atmosphere



**HEATING**

**2** IN WINTER, heat is drawn from heat sink into chiller. Via compressor it moves to condenser which delivers it to building for heating



**3** LOADS for heating and cooling any multi-story office building are varied, complicated. Note at right the loads encountered with outside temperature below room temperature on a clear day

and the condenser rejects the heat into the building. In summer the evaporator and condenser are changed from one side of the compressor to the other. On winter cycle, with zero F air as a heat source, the refrigeration system must work against extremely low evaporator pressures and temperatures. To gain efficiency a compound or two-stage system of compression must be used. This virtually excludes the use of the conventional centrifugal compressor.

Other heat sources have been used, but the aforementioned two have been the most popular.

## Which Type of System?

When our firm was selected as architects and engineers by Oklahoma Gas and Electric for the expansion of its general offices, we were instructed to investigate the possible use of the heat pump. We were striving for a system simple to operate, one with reasonable first cost, one that would allow us to use a centrifugal refrigeration machine. We wanted each item of heating and cooling equipment to be connected to either the evaporator or the condenser and to not change positions as the system would go from summer to winter operation.

At first it seemed that these requirements would make it impossible to use the heat pump. However, we had just completed a thorough study of the loads that exist within the typical multi-story office building. This study of the office building "personality" led to the development of the heat pump reclaim cycle.

## Loads are Varied, Complex

The loads that are inherent within any multi-story office building are varied and complicated. While summertime loads are all heat gain in nature, winter season loading is a combination of gains and losses. Fig. 3 shows the loads encountered with the outside temperature below room temperature on a clear day. On the positive or heat gain side are solar radiation, lights, people, and heat-generating equipment. The negative or heat loss side includes negative transmission and the heat necessary to raise the ventilation air from the outside temperature to room temperature.

Let's consider the zone loads that occur in a compact office building. Fig. 4 is a floor plan of a typical building with the area divided into an interior zone and perimeter zone. The perimeter is different in character from the interior zone in that it has both heat gain and heat loss. Heat gain is in the form of solar radiation, lights, and people, with heat loss occurring as negative transmission. The interior zone loads appear as the heat gain from lights and people only.

The interior, when protected by a well-controlled perimeter zone, will generally have only heat gain as the net result. This means that the interior zone must be cooled the year 'round. However, the perimeter zone on a zero F cloudy day will have a net heat requirement equal to the negative transmission less the lights and people. If the sun were shining, the net heating load would be the negative transmission less the lights, people, and solar radiation.

As the outside temperature rises, the net heating requirement decreases until the negative transmission equals the solar radiation, lights, and people. During this very critical range of outside temperature, one room, with no solar gain, could be calling for a small amount of heat while another room, with full solar load, is forced into a cooling situation. This difficulty experienced during mild weather explains why most systems are found to operate more satisfactorily when fully loaded either in the cooling season or the heating season. The control during the intermediate season is a problem that constantly confronts the design engineer.

### What Kind of Area Control?

Load variation is handled several ways. The most common method used for Class A office space is to zone the interior area and provide 100 percent outside air possibility for cooling during the winter season when the refrigeration machines are shut down. This creates a multitude of problems, including a more complicated system of temperature controls. The greatest difficulties are the removal of tremendous volumes of outside air after it has been introduced into the space and the control necessary to deal with variations in outside air quantity.

The perimeter zone must have individual room control because of the room-to-room variations of solar radiation, lights, and people. Systems are generally used which provide each room with two mediums, one available to offset negative transmission only while the other is capable of controlling solar radiation, lights, and people.

Each room is equipped with a thermostat that varies the potential of one or both sources to balance the load.

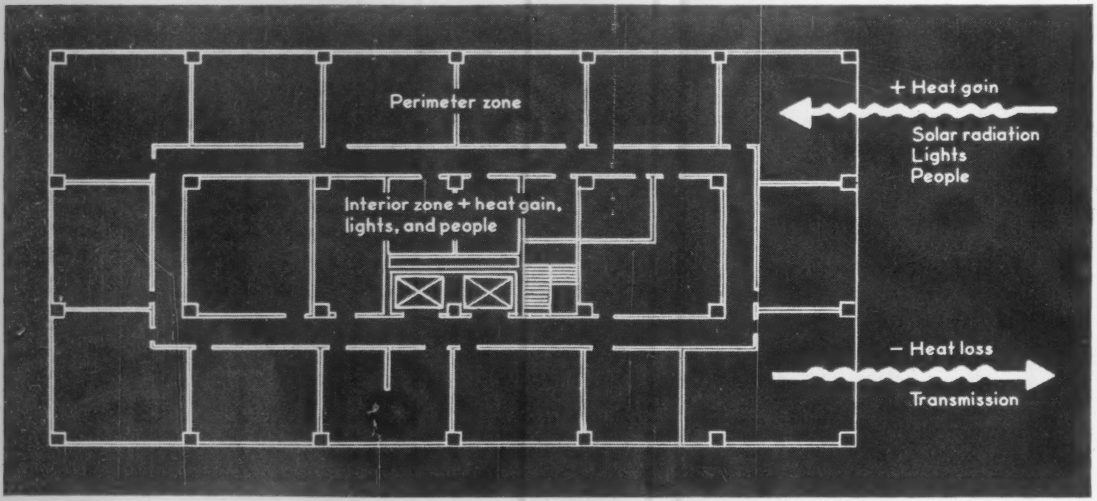
### A Clue to the Answer

Taking all of these factors into consideration we realized that much of our difficulty could be eliminated if chilled water were made available during the entire heating season. The interior and exterior zones could be simplified by omitting all ventilation control and the necessity for 100 percent outside air being admitted. This would decrease the first cost of the mechanical system and return to the owner expensive usable space which would not be needed for relief shafts.

Also, with chilled water available, all of the ventilation air brought into the building could be taken through the primary air unit and more properly treated. This would result in the complete control of space humidity throughout all seasons.

Could we meet this need for the availability of chilled water during the winter cycle and at the same time provide the necessary load for the heat pump? With this in mind we looked through the building for other possible heat sources. Many good ones were found—electronic computers, elevator motors, elevator motor-generator sets, transformer vaults, and the toilet exhaust system.

After evaluating the magnitude of these heat sources we felt there might be an outside chance of loading the heat pump with the heating within the building itself. Before we started our analysis we



**4** FLOOR PLAN of typical office building is divided into interior, perimeter zones. Characteristics of loads in these zones are vastly different

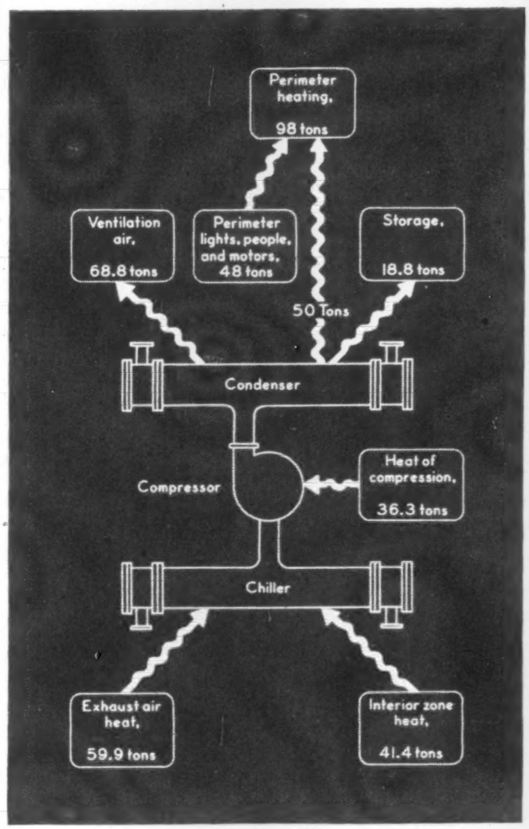

Perimeter heating, 98 tons
Ventilation air, 68.8 tons
Perimeter lights, people, and motors, 48 tons
Storage, 18.8 tons
50 Tons
Condenser
Compressor
Heat of compression, 36.3 tons
Chiller
Exhaust air heat, 59.9 tons
Interior zone heat, 41.4 tons

Fig. 5

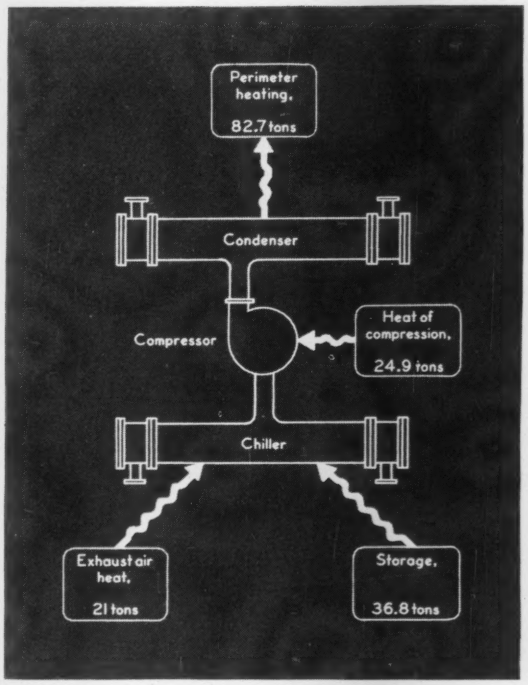

Perimeter heating, 82.7 tons
Condenser
Compressor
Heat of compression, 24.9 tons
Chiller
Exhaust air heat, 21 tons
Storage, 36.8 tons

Fig. 6

**5-6** HEAT BALANCE was calculated for various outside conditions. Fig. 5 represents loading on 13 F day with no solar gain; Fig. 6 is 13 F night with room temperatures dropped to 60 F

discarded all the above heat sources but one. In an effort to keep the system as near to what you would find in a conventional building we decided to extract only the heat from the toilet exhaust and the electronic computers.

## Calculate Load Balance

To balance the load situation we found the following heat available to offset negative transmission and to load our refrigeration machine:

1) Lights (4 watts per ft)
2) People (100 sq ft per person)
3) Motors (air handling unit fans, etc.)
4) Electronic computers
5) Toilet exhaust cooled from 76 F to 48 F
6) Solar radiation on clear days

To give us the load picture, a heat balance was calculated at various outside conditions. Figs. 5 and 6 show an example of the results of these calculations. Fig. 5 represents the loading on a 13 F day with no solar gain. Heat available to load the machine is found to be 59.9 tons of toilet exhaust heat and 41.4 tons of interior zone heat. While going through the machine to the condenser, 36.3 tons is picked up in heat of compression, which gives a total of 137.6 tons to be distributed to the building for heat. The ventilation air requires 68.8 tons and the perimeter zone needs only 50 tons from the condenser because of the 48 tons created by lights, people, and motors already in the space. This leaves an excess of 18.8 tons available to go into storage for nighttime use.

Fig. 6 shows the heat balance for a 13 F night and the room temperatures depressed to 60 F. Available for the evaporator are 21 tons in exhaust air from the original building and 36.8 tons from the previous day's storage. This is added to 24.9 tons as heat of compression, giving a heat rejection of 82.7 tons to balance the heating requirement in the perimeter zone.

For a picture of the full range from −10 F to 100 F, Fig. 7 was plotted. Everything above the zero abscissa line is heat gain, with the heat of compression added to each element.

Everything below the zero abscissa line represents heat loss. The line labeled "Lights, people, motors, plus 39 percent heat of compression" represents lights, people, and motor heat with heat of compression added to the lights, people, and motors in the interior zone only. During winter cycle in the area from zero F to 50 F, the lights, people, and motors in the exterior zone will help offset negative transmission and these gains will never be realized.

# HEAT PUMP RECLAIM SYSTEM

When on summer cycle from 40 F to 100 F, the total building lights, people, and motor heat load reaches the evaporator which requires us to show the total heat of compression in this area.

The ventilation air line represents the condenser heat necessary to warm the outside air from various outside temperatures to room temperature. The transmission line is heat loss from the building at 76 F to the various outside temperatures. The ventilation and transmission heat loads are zero at 76 F and increase proportionally with decreasing outside temperatures.

The exhaust air reclaim line shows the maximum heat gain possible from the toilet exhaust air by cooling from 76 F to 45 F. This quantity is increased by the heat of compression because the heat goes back to the evaporator. The dashed line from point *a* to point *b* represents the heat that must be taken from the reclaim coil units to hold the building in balance.

## Zero Reclaim at 35 F

Zero reclaim is necessary at 35 F where the lights, people, and motors equal the ventilation air and transmission heat requirements. As the outside temperature drops, more reclaim heat is required to load the machine, until 6.5 F is reached. At this point the lights, people, and motors and full reclaim balances the increased ventilation and transmission heat requirements. Below 6.5 F auxiliary heat must be used. The quantity of auxiliary heat necessary is represented by a line running through points *c* and *d*.

Solar heat gain is shown as a relatively flat line, with an increase for heat of compression above 40 F on summer cycle. The line through points *e* and *f* represents the amount of reclaim heat necessary to maintain the system in balance when the sun is shining. A balance is obtained at 24.5 F with no reclaim, and full reclaim is required at −4 F. The line through *g* and *h* represents the amount of auxiliary heat necessary to balance heat loss below −4 F when the sun is shining.

The area bounded by points *a*, *b*, and *j* represents heat available for storage at the various temperatures from 6.5 F on up through the changeover range. This heat can be stored during the daytime for use during the night. This storage capacity can be materially increased on clear days to include the area below line *e-f*.

The area between 40 F and 50 F is shown here as the changeover range to tie the chart in with the rest of the air conditioning system. This range represents an area in which, by design, the air conditioning system serving the perimeter zone can operate on either summer or winter cycle. This is a functional convenience which is usually designed into a conventional system which uses a combination of primary air and secondary water. This range has no significance here, except that during this period certain loads pick up heat of compression on summer cycle, but lose it on winter cycle.

## Must Use Outside Heat Source

After study of the graph we are able to see exactly how the various heating and cooling loads will move and what might be the limitations of a system of this kind. First of all, discounting solar heat gain because of the possibility that cloudy weather might coincide with low dry bulb temperatures, we find that an outside source of heat must be used to carry the building from 6.5 F on down.

**TABLE 1—*WEATHER ANALYSIS* for Oklahoma City covers 31 years for December, January, February. Percentages are of total number of days that temperature fell within each range .**

| Temperature range, F | Days, percent of total | Nights, percent of total |
|---|---|---|
| 29 to 24 | 3.0 | 18 |
| 23 to 18 | 0.7 | 13 |
| 17 to 12 | 0.8 | 6 |
| 11 Down | 0.04 | 4 |

In the "reclaim system" this was accomplished by the installation of twelve-10 kw electric heating elements on the evaporator side of the refrigeration machine. We reasoned that we must use a method of extremely low first cost —even at the expense of high operating costs. It was felt that it would be extremely hard to justify expensive equipment to cover a temperature range of infrequent occurence and short duration.

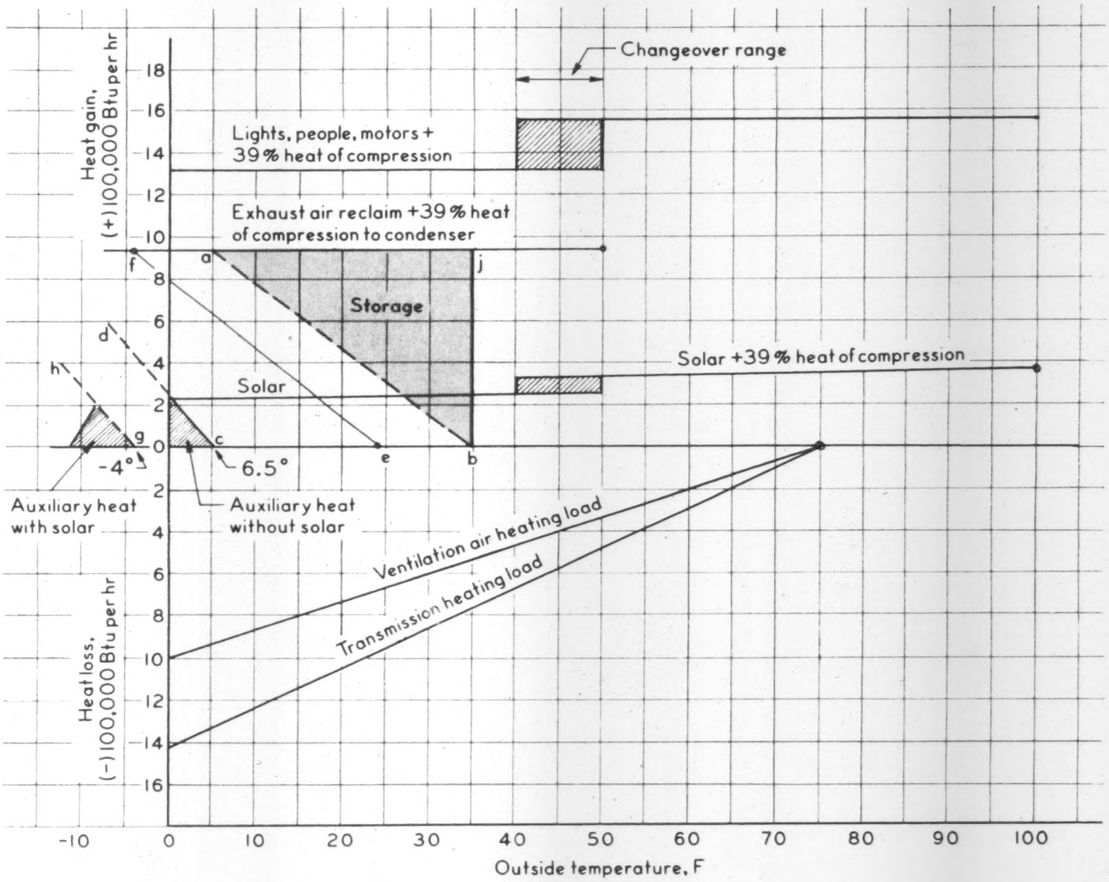
Further study of the chart in Fig. 7 revealed a need for dealing with nighttime periods when the heat from solar radiation, lights, and people can no longer be used to offset building heat loss and load on the refrigeration machine.

First, the heating load would have to be cut to an absolute minimum. To do this, we arranged the system so hot water could be circulated in the perimeter zone only and the primary air handling unit could be shut down. This would enable the building to be held at a reduced temperature of 60 F to decrease transmission losses and, by securing the air handling unit, no outside air load would be put on the system.

We found that by storing excess heat in a storage tank from the preceding day the great majority of the nights could be carried and with only a few isolated cases needing the help of the electric heating elements located in the storage tank. However, at 10 F no heat whatever would be required from the heating element or the storage tank if the lights were left on.

## Explore Temperature Limits

By the use of a chart we were able to find the temperature lim-



**7** LOAD PICTURE through full range from −10 F to 100 F is presented graphically above. Everything above zero abscissa line is heat gain; everything below is heat loss

itations of the reclaim cycle and devised a means of correcting its shortcoming. However, we still needed to know the frequency of temperatures in the critical lower ranges. For help, we turned to the weather bureau who supplied us with Oklahoma City's daily minimum and maximum temperatures covering the last 31 years. To simplify our investigation we used temperatures found during December, January, and February — the three coldest months. Four temperature ranges were set up from 29 F to zero F or below.

Assuming that maximum temperatures occur during daytime and minimums at night, we counted the number of day and nighttime temperatures that occurred in each range over the 31-year period. Then all of these were totaled and the percentage of occurrence was calculated for each range. The results are recorded in Table 1.

Only 0.04 percent of the days and 4 percent of the nights had temperatures 11 F and below. This means that on only 4 days in 10 years was the temperature 11 F or below during the three coldest months. On 95 percent of the days and 59 percent of the nights, the temperature would be 30 F or above.

This investigation showed that the auxiliary heat from the electric elements would be needed very few times a year. Also it indicated that a great majority of the 11 F or below nighttime temperatures could be handled by heat stored from the previous day.

## Perimeter System Design

The perimeter area is served by primary air and radiant panel ceilings. Secondary water is circulated in the radiant panel ceiling, using hot water in the winter and chilled water in the summer. This secondary water is the only element of the system that must be changed from one side of the compressor to the other. All other parts stay on the evaporator or condenser regardless of season. The perimeter individual room control is accomplished by modulation of the water quantity in the radiant panel ceiling at the direction of a room thermostat.

# HEAT PUMP RECLAIM SYSTEM

The primary air, which is almost 100 percent outside air, is delivered to each area to control the humidity, furnish the total building ventilation requirement, and provide the flexibility necessary during the changeover range.

The outside air enters primary air unit No. 1 through an electrostatic precipitator for cleaning. Then it travels through a preheat coil, a spray coil dehumidifier, a reheat coil and through a high pressure fan into the high velocity duct system.

On winter cycle the preheat coil and sprays are in use and the cooling coil and reheat coil are shut down. On summer cycle the spray cooling coil and reheat coil are in operation, and the preheat coil is not active.

## Interior Uses No Outside Air

The interior zone is served by air handling unit No. 2, a low pressure multizone unit with a zone for each floor and a separate zone for the electronic computer room. The unit has no need for an outside air connection because the outside air brought into the perimeter zone is ample to satisfy the perimeter and the interior zone as it passes through on its way out of the building. The unit has a cooling coil with 40 F chilled water circulating through it at all times. A heating coil was placed in the hot deck and is controlled by a gradual switch located on the central control panel. This heating coil is normally shut down, but it is always ready if the temperature drops to 60 F during the night or over weekends. Actually, this heating coil is seldom if ever used.

The toilet exhaust system is served by a draw-through air handling unit with an air filter and a chilled water cooling coil only. This system exhausts 90 percent of the ventilation air brought into the building through the primary air unit, leaving 10 percent in the building for exfiltration. When the heat pump reclaim cycle needs heat, chilled water is diverted through the cooling coil and heat is extracted from the toilet exhaust to provide load for the refrigeration machine. With 40 F chilled water available, the air can be cooled from 76 F to 45 F, if necessary.

Rather than purchase a chilled drinking water machine, with compressors, chillers, etc., a shell-and-tube cooler was installed using as coolant the 40 F water from the heat pump system. The heat extracted from the drinking water actually helps to heat the building, but the amount is rather insignificant. The main purpose here was to provide a dependable supply of 50 F drinking water with only the addition of a small heat exchanger.

## Reclaim Cycle Design

The complete reclaim heat pump cycle is shown in Fig. 8 including each system element, the refrigeration machine, and the three separate water systems. The chilled water system is comprised of cooling coils in the reclaim units, air handling unit No. 2 (interior zone), and air handling unit No. 1 (primary air). A constant flow is maintained in the cooler with diverting valve V-3 on the reclaim coils and a diverting valve on the primary air coil. The interior zone cooling coil runs wild.

Three-way valve V-1 is part of the heat pump control system and brings in warm water stored in the storage tank to load the refrigeration machine when there is a shortage of heat in the system. The secondary water system serving the radiant ceiling panels uses primary chilled water during summer cycle to maintain 55 F. Automatic shutoff valves have been used to simplify changeover of the secondary water from the chilled water system to the heating water system.

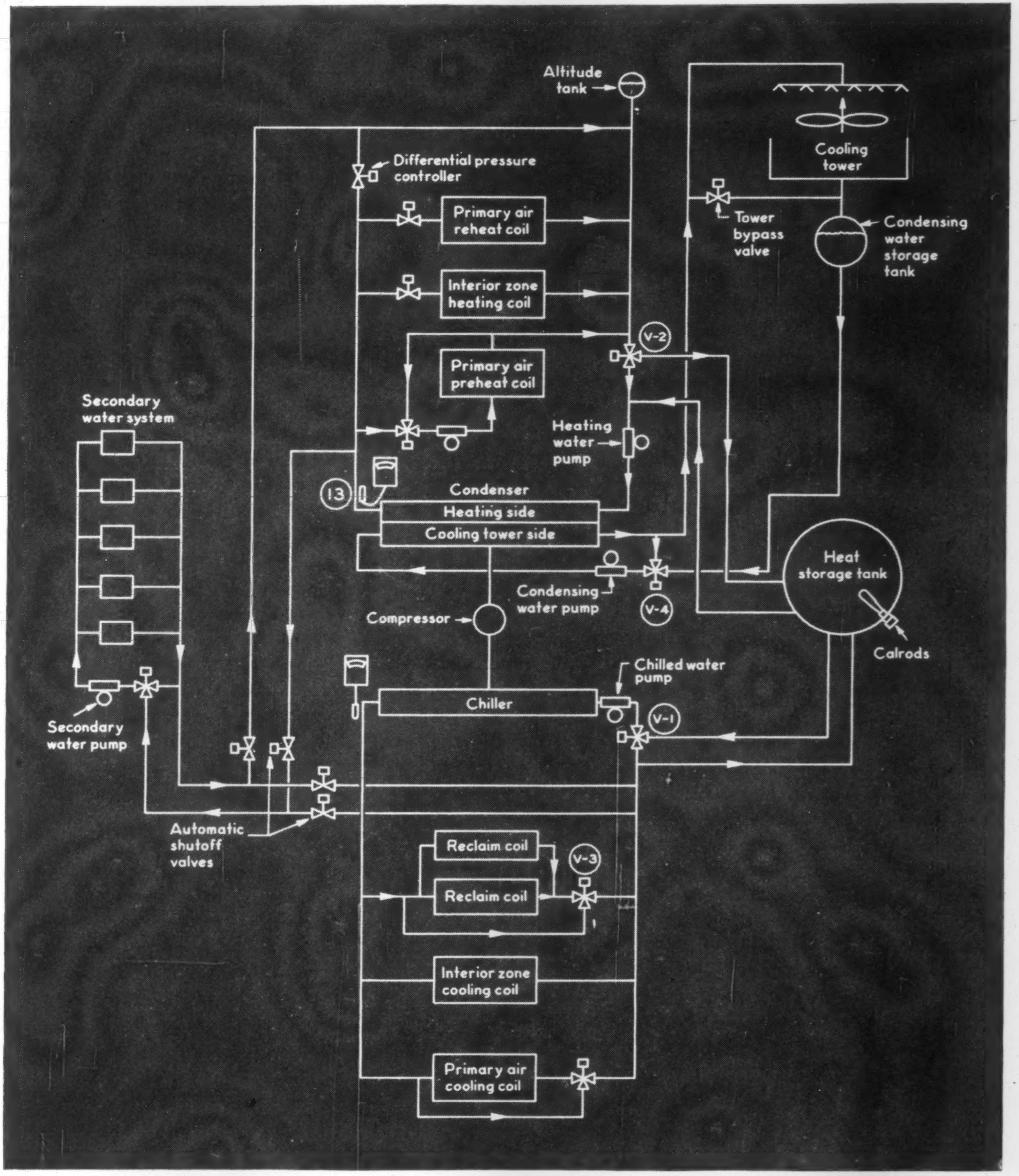
When heating water is needed, the heating water pump circulates water through the refrigeration machine condenser. Here, heat is picked up and circulated through the reheat coil, preheat coil, interior zone heating coil, or secondary water system as the season dictates. Valve V-2 is part of the heat pump control system. When there is an excess of heat being rejected by the condenser, it diverts hot water into the storage tank to be held for nighttime use.

Heat storage is in a 7000 gal insulated steel tank where hot water can be stored for future use. Also, here is where the electric heating elements are located for auxiliary heating. Hot water from the tank can be used directly in the secondary water system for mild nighttime operation with the refrigeration machine shut down or it can be bled into the chilled water system to load the refrigeration machine.

The condensing water system is composed of a standard cooling tower operated as a dry basin with all the water carried in a tank below the tower in the heated space. This was necessary because the entire system had to be ready to run at all times.

To prepare for operation of this tower during freezing weather, the fans are cycled by outside temperature. To prevent freezing of the tower filling, a control valve diverts water into the tower basin, thus holding up the temperature of the condensing water.

One of the great problems in the development of this system was to separate cooling tower water from heating water. The problem was solved by an oversize condenser with standard spilt heads. The heating water is put through the top tubes and the condensing water through the bottom tubes, putting the heating water in a closed system with no possibility of contamination. With the split condenser, each system can be opened up separately for inspection without disturbing the other or securing


Altitude tank
Differential pressure controller
Primary air reheat coil
Interior zone heating coil
V-2
Primary air preheat coil
Heating water pump
Cooling tower
Tower bypass valve
Condensing water storage tank
Secondary water system
13
Condenser
Heating side
Cooling tower side
Heat storage tank
Condensing water pump
V-4
Compressor
Calrods
Chilled water pump
Chiller
V-1
Secondary water pump
Automatic shutoff valves
Reclaim coil
V-3
Reclaim coil
Interior zone cooling coil
Primary air cooling coil

**8** COMPLETE CYCLE for heat pump reclaim system is shown above. Vital keys to operation are valves V-1, V-2, V-3, and V-4, and water temperature sensing point (13)

the refrigeration machine. Valve V-4 (See Fig. 8) is used in the control of the heat pump and will be discussed in a later paragraph.

The refrigeration machine is a conventional centrifugal open type compressor with a wound rotor motor. To give the needed 130 F water off the condenser and 40 F water off the cooler, a three-stage compressor was specified with a 300 hp motor. If the radiant panel system had not been used in the perimeter zone, a lower water temperature could have been used which would have enabled us to install a standard two-stage hermetic machine.

The machine was selected to deliver, on winter cycle, 2.5 million Btu per hr while supplying 130 F heating water and 40 F chilled water. On summer cycle and the machine will produce 220 tons of refrigeration by cooling the chilled water to 40 F when supplied with 85 F condensing water.

Leaving chilled water temperature is controlled by automatic modulation of the suction damper with manual changes in the compressor motor speed. Also, the machine is equipped with two manual hot gas bypass valves used to prevent light load surging.

Again, note that no manual valve changing is necessary when going from summer to winter. With the exception of the secondary water system, each element is connected to one side of the machine only. The significance of this fact can be found by the extreme ease in operation of this system.

## Control Condenser, Chiller

The heat pump control system is divided into two elements: control of the condenser output and control of the chiller output. The chiller water temperature is maintained at 40 F, as described above, by manual changes in compressor speed and automatic modulation of the suction damper.

The heating water temperature is controlled by modulation in sequence of valves V-1, V-2, V-3, and V-4. This is divided in two cycles: store cycle and run cycle. When on store cycle the heating water temperature controller calls for 130 F water to allow the maximum heat capacity to be stored in the storage tank. When the tank reaches 130 F or maximum storage capacity, the system is then turned to the run cycle. This allows the controller to be reset by outside temperature, calling for lower heating water temperatures during mild weather.

System operation can best be described by following a normal winter morning startup. The heating water temperature is down and the heat storage tank has been depleted. When the machine is started up, the heating water controller senses the water temperature at point 13 (Fig. 8) and, with the system on store cycle, the controller calls for 130 F heating water. With the heating water system below that point, valve V-2 is bypassing the tank, V-3 is full reclaim, V-4 is full bypass, the condensing water pump is secured, and V-1 is modulating to draw water out the of the tanks thus loading the machine.

To keep water that is too hot from going on the machine and overloading the compressor motor, a high limit thermostat, located in the chiller water to the cooler, limits the travel of valve V-1. A line voltage thermostat in the storage tank controls the electric heating elements to maintain a minimum 50 F in the tank. In this way the auxiliary heat is brought in only when needed.

As heating water temperature nears the control point, valve V-1 modulates until the tank is fully bypassed. Upon a further increase in water temperature, valve V-2 assumes control and diverts hot water into the storage tank. When storage tank temperature has been built up to the temperature of the heating water system, V-2 will be on full tank.

With a further rise in heating water temperature, valve V-3 will assume control and divert water around the reclaim coil units to unload the refrigeration machine. When V-3 is near full bypass, the condensing water pump is automatically started with V-4 still in a bypass position.

When V-3 reaches full bypass and if the load picked up in the cooling system is greater than can be rejected to the building heating system, valve V-4 modulates to reject the excess heat to the cooling tower. When heating water is no longer needed, the heating water pump is secured and the system is locked into summer cycle. Valve V-4 is full tower and valve V-1 is still full bypass.

What has been described is a situation of decreasing heat load from full heating to full cooling. On increasing heat load the system functions the same except, of course, in reverse. The system may seem complicated, but the valve sequencing is a simple thing to do, evidenced by the lack of trouble that has been experienced with this system.

When the storage tank temperature has reached the heating water temperature the system can then be changed to *run cycle*. Now the heating water temperature is reset by outside temperature increasing the water temperatures as the outside temperature decreases. For example, when the outside temperature is 45 F, the system does not need 130 F water, but something lower. Holding the heating water temperature as low as possible improves the overall efficiency of the system and helps the functioning of temperature controls during light loads. On run cycle, valve V-2 is locked into tank bypass position and the heating water temperature is controlled by modulating valves V-1, V-3, and V-4 in sequence.

## Where the Difference Lies

One thing that should be stressed here is that this system differs very little from a conventional system. The entire installation is the same as we would have had with a boiler, except for the reclaim coil units in place of exhaust fans, the heat storage tank, and the four valves in the heat pump control system. All we have done here is substitute the refrigeration machine condenser for the boiler. Also, by having chilled water available the year 'round, we were able to eliminate ventilation control on the air handling units, materially decrease the primary air quantity, and eliminate the need for a large relief fan with its inherent complexity.

In addition, all outside air is brought in through the primary air unit where absolute control of moisture content and cleanliness of the air can be maintained at all times. ╪

# More Finny Troubles to Prove a Point

By LESTER T. AVERY
President
Avery Engineering Co.

THE SUBJECT of fins and fin spacing as mentioned in my article, *Too Many Fins Can Bottle-Neck Heat Transfer*, in February is still under investigation. I have received some comments on this article from several interested persons, and, in general, the manufacturers seem to be taking a closer look at the advisability of close fin spacing. For ourselves, we've been trying to trace service problems that could be attributed to fins clogging up with dirt, frost, or water and, based on this season's experience, have made the following observations:

On a standard package heat pump, where the unit was installed in a shop to deliver cooled or heated air to a small adjoining office, the condenser-evaporator stopped up with dirt within a period of three months causing a serious service problem. Our service department added a filter to the air intake and, in the course of time, the compressor burned up. Our observation at that time was that the filters were completely stopped up with dirt, although they had been in operation only six weeks. The heat pump evaporator-condenser combination is one where airborne dirt has given troubles due to close fin spacing.

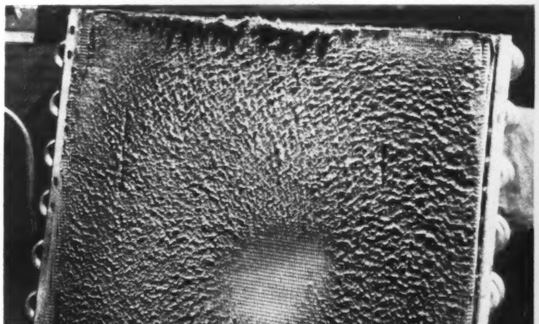
On a 50-ton heat pump condenser-evaporator we observed obvious collection of snow under certain weather conditions. When this snow would freeze into ice on the coils, the close fin spacing made defrosting difficult. When I say difficult, I mean that we found it necessary to defrost every two hours. Otherwise, the accumulation of snow and ice could not be defrosted in a reasonable time. The refrigeration machine was being used to cool the store entirely too long in order to get the defrost. I emphasize this point here because the cold wind blowing through the evaporator when it is defrosting tends to keep the ice on the coils, thus prolonging the heat pump defrost period and increasing its cost. The close fin spacing which could be considered necessary for hot climate condensing acts against you in the heat pump defrost cycle operation. My observation on this is that the air cooled condensers, when they are to be used for heat pump evaporators should have 6 fins per in. or even less.

Further observation of dirt accumulation on ordinary condensers with 13 fins per in. is illustrated in Figs. 1 and 2. Dust accumulation follows an interesting pattern, as will be noted in Fig. 1. As this was a propeller fan operated condenser, it would appear that no air, and therefore no dirt, was going through the center of the coil. Fig. 2, illustrating the condenser after it was cleaned, shows that the arrangement of the fins was actually a pretty good filter.

One further observation on a package unit with close fin spacing on the coils is that after three years of operation, although the filter was new and clean, the air flow had become so restricted that the compressor short-cycled on the suction pressure and pumped oil out. This led to the ultimate destruction of the compressor. The cure was to clean the cooling coil of the mud which had accumulated from dust and water from condensation.

These observations are factual. They may indicate a trend to more primary surface and less superficial fin surface which, as formerly suggested, may cause troubles to the compressor or compressor motor. ǂ

**1 THIS AIR COOLED CONDENSER** was observed after one year's service. Note pattern of dust accumulation, indicating that no air was going through center of coil



**2 SAME CONDENSER CLEANED,** compared with Fig. 1, shows what an effective dust filter the unit actually is. This is hardly its purpose

*Operating experience in this new ammonia plant shows . . .*

# Process Piping Design, Fabrication Demand Special Care

By LOWELL G. CROYSDALE
Mechanical Engineer
The Best Fertilizers Co.

As in any special purpose installation, the design and fabrication of the highly complex piping system required for an ammonia plant present specific problems unique to the kind of duty expected from this system.

This, of course, involves much more than mere proper sizing of the lines, fittings, and accessories. Gases and liquids carried in this kind of processing vary widely in composition and effect — from noncorrosive to highly corrosive, safe to extremely dangerous — and in temperature ranges from −300 to 2200 F.

Obviously, such processing requires careful selection of materials, together with precise correlation to the pressure and temperature capabilities of the various parts in the system. This can get quite involved. For instance, one important factor to be considered is the concentration of the solutions to be transported, or the "wetness of gases."

Ordinarily steel pipe, for example, is quite satisfactory for a line carrying concentrated sulfuric acid under normal temperature condi-

• While pressure and temperature requirements are the main factors in process piping design, special applications, such as the ammonia plant piping system described in this article, can impose a variety of design problems. These can be satisfied only after a thorough analysis of all factors has been made. Piping for the process industries naturally requires carefully selected materials. Cleanliness, always good practice for any piping system, is an absolute "must" here—as is prevention of leakage. In the long run, with the higher-than-normal cost of some process piping, such judicious design can effect big savings.

tions, or where temperature fluctuations are of an ambient nature. The same pipe cannot be used, however, for the much more corrosive dilute solutions of the same acid or where high temperatures will be encountered.

At any rate, it is apparent that each product to be transported must be considered by both physical and chemical analysis and in light of the conditions under which it will be moved. One factor often overlooked in this kind of installation is that sudden changes in pressure at valves, or even slight pressure drops at an orifice flange, can liberate an entrained gas from solution, producing an immediate and serious corrosion problem.

Without attempting to survey the whole problem of ammonia plant piping, a brief look at some of the difficulties we encountered and some of our methods of obtaining the best possible operation should be useful.

## Cleanliness Is Mandatory

One of the most costly errors is the improper fabrication of compressor piping. Cleanliness is always an excellent practice, but when high pressure compressors are connected to a system, cleanliness is an absolute necessity.

It is a gratifying experience for an engineer or piping contractor to witness the startup of a series of high pressure compressors without a serious loss of time due to damage from dirt left in the piping. Many methods are utilized to preclean piping either before fabrication, after fabrication, or after installation. The method which we use has proved very successful and has resulted in an abnormally low wear rate for piston rings, plus minimum breakage of valve plates. After more than a year in operation, spare parts obtained with the compressors are for the most part still in stock.

Prior to awarding the piping fabrication and installation contract, we made a study of available cleaning methods and inspected the fabricators' available facilities. We recognized that any cleaning process would be only as good as the equipment and operators involved.

Both sandblasting and chemical cleaning were considered, and actually both were used. All piping was purchased chemically cleaned on the inside only, and properly protected from rust by chemical and physical means.

Icicles and welding beads have a habit of breaking loose. One small bead can seriously damage a high pressure compressor. Therefore, each joint was made with backup rings or was ground internally after fabrication.

All pipe was then chemically cleaned by a vat method, so that no air pockets would prevent complete cleaning effectiveness. By always keeping one end of a fabricated section high, satisfactory contact in all baths was insured.

The first bath was in an alkaline solution which completely removed all grease and oil. This was followed by a thorough water rinse, an acid bath, another rinse, a neutralizing bath, and a final immersion in water soluble oil.

Although metal cleaned in this manner has been exposed to the weather for months without rusting, we sealed the ends of all pipe with light metal caps and covered each flange with a wooden protector. The protectors not only prevent rust but precluded the possibility of foreign bodies entering the pipes.

The final step was to see that no covers were removed until the piece was ready to be bolted into place or welded. Remaining open ends were kept sealed.

To prevent damage to the compressors from human errors, cone screens were installed in all suction lines. Before beginning the compressor break-in run, all lines were thoroughly blown using air and the compressors themselves. During this operation screens were inspected periodically. We have found only a minimum amount of foreign matter collected. In short, this method of assuring cleanliness has paid off very well.

### Must Prevent Leakage

The presence of highly explosive hydrogen in part of the system required particular care to prevent leakage. We inspected and cleaned all flanges and gaskets, and required that no compressible gaskets, except those of ring-joint design, be re-used. Flanges which were not parallel were brought into alignment. Care was taken to see that load was distributed equally over the gasket areas.

In the ammonia service system, all possible joints were welded to avoid personnel danger from leaks. On sizes 2 in. and larger, butt welds were used, while the 1½ in. and smaller lines were socket welded, including joints for valve takeoffs. Considerable care was necessary with these small valves to prevent seat warpage.

Where possible, valve stems and seats were removed during the welding operation and the valve bodies cooled with wet rags. When welded bonnet valves were installed, they were kept in the open position and wrapped with wet rags. Here again, the lack of serious valve trouble since operation was begun has more than paid off for the extra care taken.

### Inspection Reveals Oversight

One oversight was discovered in connection with the unions required for the numerous instrument installations. Most of these high pressure unions include an insert on the female side. Here, a number of leaks developed. Inspection showed that heat from the welding operation had warped or loosened the seats, and replacement became necessary.

After the system was fully erected, testing proceeded as follows: gas, water, steam, and most small or low pressure lines were hydraulically tested to 1½ times the designed operating pressure. This required many vents, drains, and blinds. Often, equipment had to be isolated to prevent damage.

The ammonia synthesis section of the piping system was tested in a step-by-step pattern to a pressure 1½ times the 3000 psi operating pressure which would be encountered in processing the dangerous synthesis gas which contains both hydrogen and ammonia.

This process involves combining hydrogen and nitrogen introduced from different systems under lower pressures into the high pressure synthesis "loop"; therefore, the procedure allowed us to correct any intersystem leakage.

Although a liquid seam testing material was used to locate leaks, the testing with nitrogen allows rapid location of leaks because of the frosting which occurs when escaping nitrogen expands rapidly.

Valves were especially tested for both packing leaks and for closure leak-through. If it becomes necessary to use too much force for valve closure after the system is in operation, valve seats and discs might be damaged or stem seizure may be experienced.

### Piping Costs Are Kept Low

It would be well to note again that we were able to effect considerable savings in piping costs by a careful study of the processes which will be dealt with. Since the cost of piping in an ammonia plant comprises a larger than average percentage of total plant cost, such savings are of real importance.

In general, pressure and temperature requirements are the controlling factors in the selection of materials. We have established less stringent requirements for certain parts of the installation where process conditions would allow. For example, A-53 pipe was used in sections of the synthesis system where lower temperatures are expected. In other sections of the same loop, the anticipated high temperatures required 1½, 5, and up to 9 percent chrome content with ½ percent moly.

Another combination has been found suitable for the MEA system — monoethylomine saturated with $CO_2$ — where carbon steel pipe has proved satisfactory on the high pressure side, but stainless steel type 304 was required in the line from the pressure reducing valve to the vessels.

Computation of the "economical life" in one section has allowed us to use Schedule 80 pipe where stainless steel might otherwise have been required.

To date, the only difficulty encountered has been in this condensate recovery line of Schedule 80 pipe, where serious corrosion due to turbulence and pressure reduction has been found at orifice flanges and on the low pressure side of the reducing valve. It is expected that this condition can be corrected by replacement of only a few feet of the line at these points with stainless steel pipe.

Many other problems peculiar to this type of ammonia plant installation are, of course, encountered. Among them are hydrogen embrittlement, caustic embrittlement, phase changes in stainless steel, and carbide precipitation.

The metallurgical sciences are continually making the design of such systems easier, but we have found that only experience can adequately prove the choice of a new material for many applications.

The success of this project, like any such project, resulted from the excellent cooperation and advice of the engineers involved, the piping contractor, and the vendors.

‡

Steam turbine driven units provide heat, and fan-coil units supply cooling — because, at Ten St. Mary Street . . .

# Separate Systems Meet Tenant Control Demands

● Heating and air conditioning services for newly constructed office buildings do not have to suffer at the expense of architectural appeal. In fact, building esthetics and mechanical function can be well integrated without compromise. This was done in the construction of the Ten St. Mary Street building in Toronto. Satisfying heating requirements meant "inventing" a suitable system which could use as much commercial equipment as possible to take advantage of the economics associated with mass production. Steam turbine operated fan unit heaters were selected, with steam supplied from two packaged boilers in the building basement. One of the features of the heating system is its control system, the design for which is very interesting. Air conditioning is separate. A 150 ton centrifugal refrigeration machine provides continuous circulation of chilled water to air conditioning units on each floor. Supply air is distributed in the ceiling space between the structural slab and the suspended metal pan acoustic ceiling. Supply air, always cooler than room air, filters down through perforations in the pans, thus effecting natural air motion.

By WILLIAM KITCHEN
Chief Mechanical Engineer
Mathers & Haldenby
Architects

A MEDIUM sized commercial office building at Ten St. Mary Street, Toronto, Canada, incorporates a unique solution to the winter and summer air conditioning problems for this type of building.

The general design of the building is that of a reinforced concrete structural frame with exposed external wall columns and spandrel beams. It faces 200 ft on St. Mary St., with a depth of 52 ft, and rises eight stories, the upper seven of which are divided into office spaces.

Of a total area of 10,400 sq ft,

some 8250 sq ft are available for rental use. The ground floor and basement areas, with the exception of a small shop space and entrance lobby on the former, are devoted to parking facilities for tenants' automobiles.

Outside walls are brick, with upper floors being of shallow beam and slab design.

Floor slabs are oversized in depth to accommodate electrical distribution ducts. Designed story height is 11 ft, but the addition of perforated false ceilings throughout the building, through which conditioned air is distributed, reduces the height to 9 ft, 3 in. in the office areas. Air conditioning header ducts and return plenums utilize the corridors of the building, reducing head room in these areas to about 8 ft.

Mathers & Haldenby, architects, designed the building and occupy two floors of office space in it. The author, as the firm's chief engineer, was responsible for the design of the heating and air conditioning systems. These services were laid out with the intention of applying the best engineering practices for environmental control in a building of this type and use, and with a view toward establishing a balance between intitial installation cost and true long-term economy.

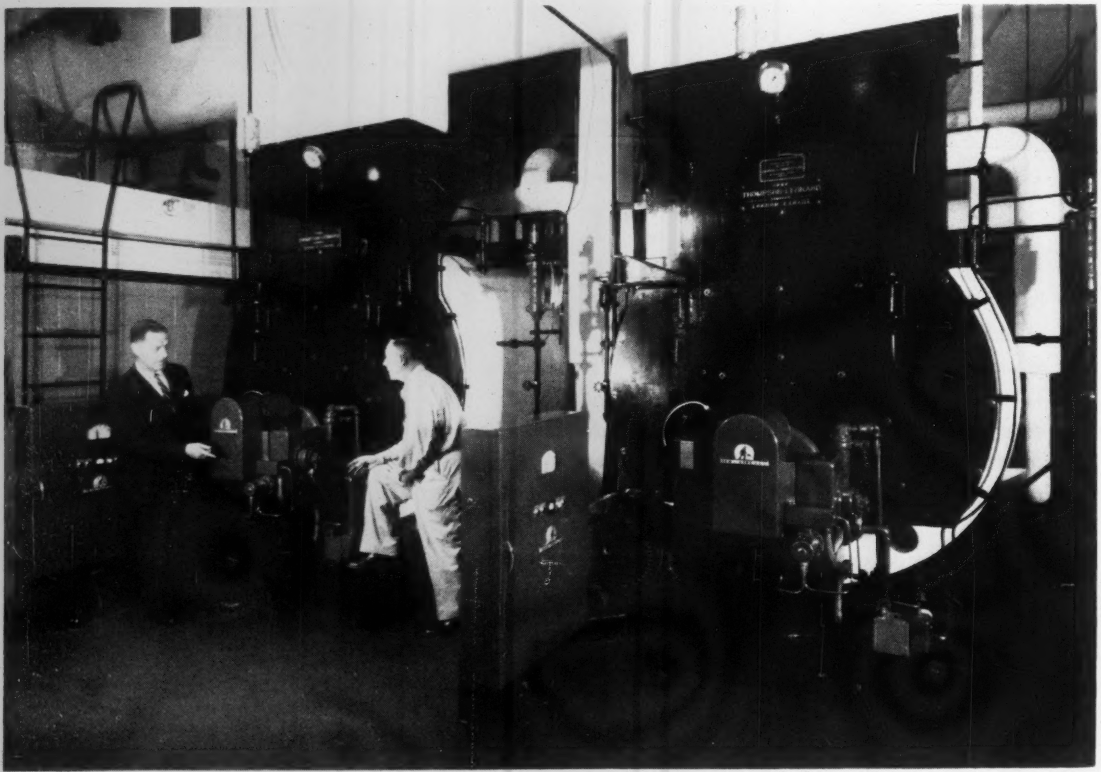
## Separate Heating, Cooling

It was decided to maintain heating and cooling functions entirely separate from one another so that tenants might adjust their own conditioned air supplies without regard to similar adjustments by other occupants.

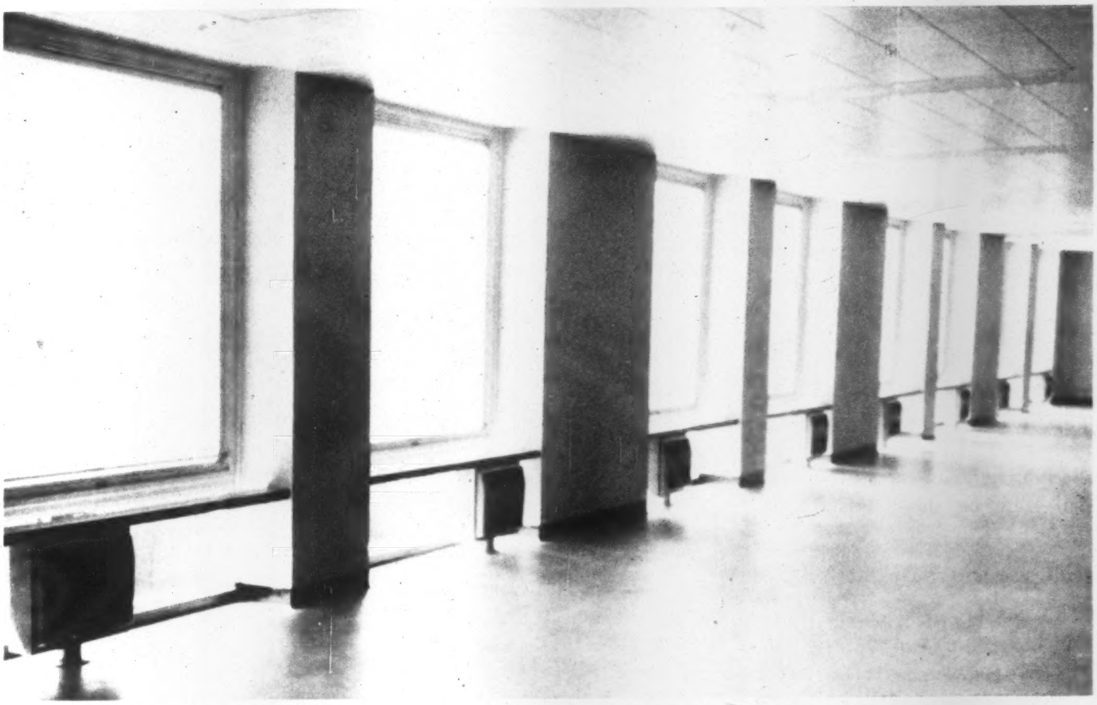
Floor-to-ceiling windows flank each vertical structural column. Each pair of windows within a span is separated by a brick pier which forms the exterior wall of the structure. The windows are divided with a horizontal sash approximately 2 ft above the floor level.

Individual winter air conditioning units were chosen to provide heating services for the upper seven stories. These are steam turbine driven fan units with individual coils that utilize turbine exhaust for the heat exchange medium within the coil. Each unit, capable of providing 18,000 Btu per hr, is enclosed in a 19 × 19 × 9 in. cabinet.

Each heater is suspended from an intergal window sill approximately 9 in. in front of the glass. The sill height corresponds with the dividing window sash in the lower part of the opening. A pipe support beneath each heater extends to the floor and provides access through the slab for copper steam and condensate lines which run to risers via the below-the-slab spaces mentioned earlier.



TWO 80 HP SCOTCH BOILERS supply steam to all heating units in building



FREE STANDING HEATING UNITS are capable of supplying 18,000 Btu per hr each for winter heating

In effect, the heaters are free-standing, and are positioned adjacent to either side of each brick wall pier. The piers themselves contain the main steam and condensate risers, which are fed from a high-level ring main beneath the ceiling of the first-floor garage.

Two-directional air streams discharge warm air from the heaters through registers positioned at the back of the heater enclosure to keep the windows free from condensation.

Individual steam and condensate shutoff valves for each heater are located on the riser connections above the removable metal ceiling panels of the floor below.

### Control Influenced Selection

The selection of this type of individual cabinet heater involved several control considerations unique to the system. We had to provide for individual conditioned air control and still effect draftless conditions with nonfluctuating temperatures.

A single thermostat control for each heater might require an extreme temperature differential to move the steam throttle toward greater output or to close the throttle when the room temperatures began to rise. Since, in the units selected, a single throttle controls both fan speed and coil input, a more sensitive control was needed to prevent hunting when a sudden demand for heat from a cold unit would cause a fluctuating fan speed and increasing supply of warm air.

The problem was solved by a more complex control mechanism supplied with the units. The throttle arrangement incorporated in each heater allows steam to be supplied to the units at all times, in quantities sufficient to keep the coils warm.

An integral "chimney" within each unit causes room air to pass over a small damper via a bimetal thermal element. When the room air is cool, the chimney damper opens and allows the air to reach a control bulb and bellows assembly which is mechanically linked to the steam throttle.

Such an arrangement allows a quicker response to room air temperature differential than would be obtained with a single-thermal element device. Increasing room air temperatures, of course, reverse the process.

While room air temperatures remain in relative equilibrium, overheating of the heat exchanger core is prevented by a heat conducting bar connected to the return condensate line at one end and to the throttle bellows control at the other. Because the admission of steam is thus controlled at all times, temperatures within the heaters always approximate those which would be maintained with hot water convectors. While the units are operating, of course, the exhaust steam within the coil approaches condensing temperature because of the energy extracted in driving the fan turbine.

Disposable air filters behind the

inlet vanes of each heater complete the arrangement.

### Heat, Ventilate Lobby Floor

Heat is supplied to the ground floor lobby by a steam coil central station unit which furnishes warm air to high velocity slot outlets positioned along one wall near the ceiling. The same unit provides summer ventilation for the lobby by drawing relatively cool air from the nearby stairwell and elevator shafts during periods of higher outside temperatures.

A packaged year 'round air conditioning unit serves the small retail store on this level.

### Steam Boilers Custom Built

Two 80 hp Scotch type wet-back boilers of two-pass design were custom packaged to our specifications and installed to provide steam for all heating units within the building. The units are oil fired with No. 5 industrial fuel. Each is served by its own feed pump, with cross-connection provisions.

Condensate returns by gravity to a tank, from which it is supplied to the boilers by electrically driven centrifugal pumps.

Summer air conditioning is accomplished in all office spaces by means of fan-coil units located one to each of the upper seven stories. Chilled water is supplied to the coils from a 150 ton electrically driven centrifugal chiller in the basement boiler room.

The air conditioning units are installed in mechanical equipment rooms on each floor and draw return air through these spaces via the corridor return plenums. Outdoor air is supplied via a vertical shaft to the roof, which is topped by a filter unit. Header ducts in the passageways carry conditioned air to office spaces, discharging above the perforated metal acoustic ceiling panels from where it descends by gravity through the rooms.

This method of supplying air, which is always cooler than room temperature, provides a natural circulation throughout the building. Conditioned air is introduced at the rate of 1 cfm per sq ft of area, of which one-fourth is outside air.

### Versatile Supervisory System

A ready-made opportunity to obtain useful information on this type of system was presented by the unique designer-tenant situation. We designed a suitable supervisory system which would provide not only accurate cost-of-operation data but also information on the general operation of the building services, such data to be applied to future design considerations.

To implement the study, somewhat more than ordinary instrumentation was included in the system. Each boiler-burner unit is equipped with a fuel consumption meter plus a resettable burner firing-time counter. Feed water make-up is checked with a consumption meter. The pH is determined manually, and a portable combustion meter is used periodically to determine carbon dioxide content.

A recording steam consumption meter and flue gas pyrometer yield additional factors which, in combination with the fuel consumption data, are used to compute overall plant efficiency. Operating data for the centrifugal refrigeration machine are gathered by means of watt and kilowatt hour meters.

These instruments, with their associated switching devices, indicating lights, and alarms, are grouped with additional controls including a chilled water temperature chart, fuel tank gage, air pressure gage, and others, on matching heating and air conditioning control consoles in the basement boiler room. The operating engineer employs a multipoint temperature indicating device from this location to determine temperatures in the various floor zones. Individual boiler room components have, of course, their own control panels, correlated with the main control consoles.

### Show Conditions Graphically

Each fan-coil unit on the second through eighth floors has a graphic panel display for temperature, relative humidity, and air flow indication. East and west zone control is provided for each floor from these panels.

An interesting solution to the mild or "in-between" weather condition during which some tenants would desire cooling and others heating service has been experienced by slight overcooling of the zone areas, with necessary reheat being obtained through the individual cabinet heaters beneath each window.

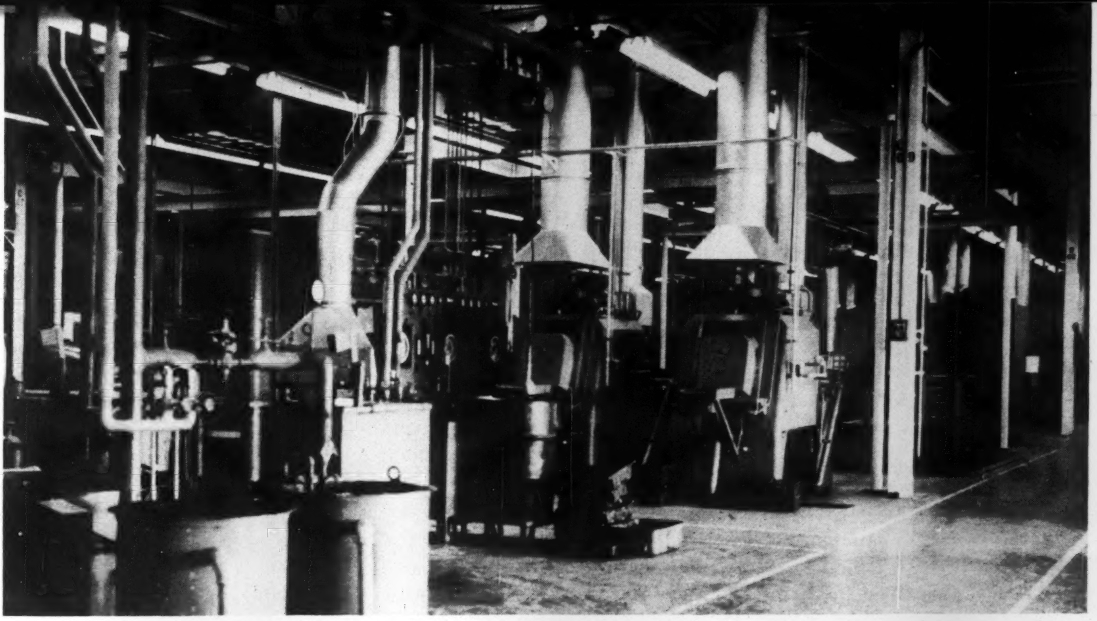
In addition, an outdoor thermometer, roof-mounted in an adjustable radiation enclosure, resets the control point of the main steam supply pressure valve, thus compensating for the solar radiation effect upon the individual heaters.

Restriction of the system to the cooling or heating function during summer and winter months can be effected by means of a switch panel in the operating engineer's office.

Experience with the system through the various seasons has indicated overall satisfaction on the part of the tenants, both for comfortable conditions and an especially appreciated general cleanliness. Operating costs, including a marked reduction in building cleaning bills, have been satisfactorily low.

The building is owned and operated by the Ten St. Mary Street Realty Corp., Ltd. The architects were Mathers & Haldenby. The Jackson-Lewis Co., Ltd. were the builders. ‡

*Photos courtesy Iron Fireman Mfg. Co.*



VENTILATION DESIGN for IBM's plating, heat treating building at its Rochester, Minn., plant posed many problems. Many assumptions had to be made, since no precedents existed for solutions of several design problems. Shown above is south half of heat treating department showing tank exhausts, furnace hoods, and spot coolers in background

# New Ventilation Design Cools Plating, Heat Treating Plant

**• Unbearable internal heat loads and a dearth of literature on many critical design problems made the design of a ventilating system for International Business Machines Corp.'s plating and heat treating building in Rochester, Minn., an engineering challenge. Some unique interpretations of standard design practices were made which have paid off well — as will be attested by two years' successful operation.**

**Mr. Hanson holds degrees in mechanical engineering and business administration from the University of Minnesota. A former mechanical contractor, he is a registered professional engineer. He was formerly employed by IBM and had project responsibility for the mechanical design and construction of the installation described in this article.**

By NEIL H. HANSON
General Manager
Des Moines Branch
Comfortrol Supply Co.
Air Conditioning Wholesalers

THE International Business Machines Corp. decision to maintain the highest possible architectural standards in design of company owned structures is reflected in the beauty of its plant in Rochester, Minn. Finished in September 1958, this installation has been referred to as one of the 10 top plants built that year.

The manufacturing processes conducted in the plant are extensive, requiring large heat treating and plating facilities. Buildings housing these functions are usually uncomfortable. But, since all other manufacturing facilities were scheduled to be air conditioned, management decided everything possible, short of complete air conditioning, should be done to make the processing building comfortable.

Since the heat treating and plating building, or processing building as we shall call it, was a new facility, ideas were incorporated into the designs that might not otherwise have been usable. Some of these ideas might be applied in similar existing buildings, with minor modifications.

The total building area is 60,000 sq ft. This is apportioned into 23,000 sq ft for plating, 18,000 sq ft for heat treating, 12,800 sq ft for support equipment for these functions, and 6200 sq ft for plant maintenance facilities. The 12,800 sq ft support area also has a basement and mezzanine to house ventilation equipment.

The plant maintenance area is connected to the rest of the plant by a large corridor. Conditioned air drawn from the manufacturing buildings by large power roof ventilators cools this area in the summer. Two large unit heaters and a row of perimeter heating coils heat the room in the winter. The perimeter heating coils, controlled by outside temperature, are used throughout the plant to offset the heat loss through the thin curtain walls.

### Ventilate Heat Treating Area

Approximately 6,125,000 Btu per hr of internal heat is released in the heat treating room. This is the total heat content of the natural gas and electricity used in the area, less the heat removed by the furnace cooling water. Sources of high radiant heat are shielded wherever possible by double metal jackets, reflective sliding doors, and radiant shields. The designs are intended to hold surface temperatures to a 190 F maximum.

Much attention was devoted to hood designs in an attempt to encase all sources of convected heat. A capture velocity of 100 fpm along the planes surrounding the high heat area of the individual furnaces and the hood edges was used in computing exhaust volumes. These volumes total 74,000 cfm and result in the exhaust of an estimated 3.5 million Btu per hr of the room total.

Furnace flue gas temperatures ranging from 1000 to 1600 F are reduced to an average of 50 F above room temperatures by this mixing with room air. Thus the large volume of exhaust air also serves to keep high temperature paint from burning off the ducts.

Nearly 70 percent of the total internal heat load is exhausted from the building through these hoods and seven roof ventilators which remove high temperature air near the roof. Each of the power roof ventilators exhausts 13,000 cfm, but the total room exhaust of 165,000 cfm is used only during maximum outside temperature conditions. The fact that such a high percentage of room heat is exhausted is a testimonial to the value of proper hood design.

### Well Water Combats Heat

Since outside summer design conditions in Rochester are 95 F dry bulb and 75 F wet bulb, the remaining 1,875,000 Btu per hr of internal heat could cause intolerable conditions. Some sort of cooling was required to meet the working conditions of comfort desired by management.

Approximately 250 gpm of water was anticipated under conditions of maximum utilization to meet heat treating furnace cooling requirements. This water comes from city-owned wells and has a year 'round temperature of 52 F. The needed cooling capacity for the ventilation air is easily obtained by passing this water through cooling coils in a supply air unit. The water temperature is thereby raised to 65 F before it is used to cool the furnaces. As a further economy, the water is recovered and is finally used for plating department rinses.

The 13 F temperature rise provides 1,950,000 Btu per hour of cooling capacity. This is sufficient to remove the internal load, but is only enough to cool the area to a temperature of 92 F under maximum summer conditions. It was decided to release the cooled air to the area through spot coolers to achieve maximum operator comfort without going to the expense of cooling the entire room.

Some supplemental heat is required during winter when furnaces are shut off during a holiday. By balancing the heat required for this purpose with the required cooling for summer conditions, a blower unit was sized to pass 70,000 cfm. A blower unit of this size should also cool the 95 F DB and 75 F WB outside air to 70 F DB and has done this under actual conditions with water flows just over 300 gpm.

The 70 F air is ideal for spot cooling. This blower unit has been designed to pass 70 F air at all times, utilizing a maximum amount of return air. Room temperature is controlled by reducing the amount of air exhausted from the furnace hoods to a 25 percent minimum and by turning *on* or *off* a 45,000 cfm blower unit designed to normally pass 65 F air by mixing outside air and return air taken from an intake near the roof. Air from this blower is delivered to seven diffusers throughout the area 14 ft from the floor.

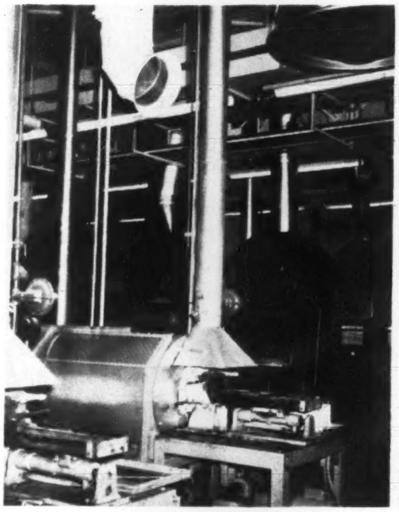
A differential pressure control maintains a slight negative room static pressure in relation to the adjoining buildings by first dampering the outside air to the 70,000 cfm supply unit and then by step-cycling six of the power roof exhaust ventilators. The balance of the supply air required comes from power roof ventilators thermostatically controlled to supply cooling air.

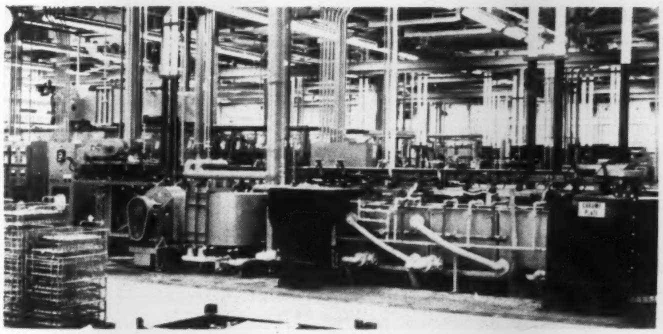
Special atmospheric gas generators are housed in a separate room of the core area because of their exceptionally high heat load and the difficulty of adequately exhausting enough of the heat released by the generators. This room has a high encased ceiling from which air, often over 165 F, is exhausted.

Outside air without prior heating or tempering is supplied to cool this room and to replace exhausted air. A slight negative pressure is maintained in the room to prevent the heat from being convected to other areas. Operators do not normally work in the room so a high degree of comfort is not necessary.

### Spot Cool Work Areas

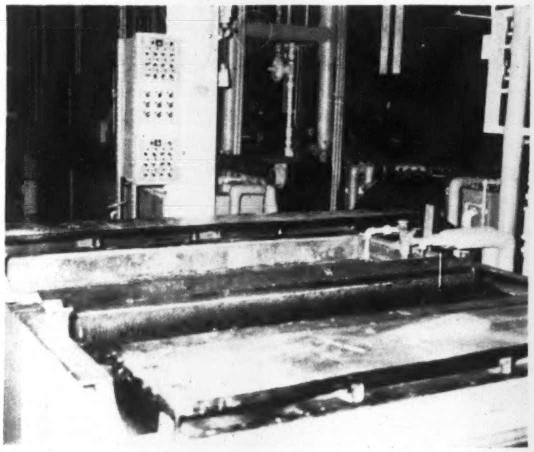
It was originally assumed air should be discharged from the spot coolers at a rate of 1000 fpm. On-the-job experimentation indicated that 800 fpm was a more comfortable rate. Utilizing this latter rate, 350 cfm is discharged



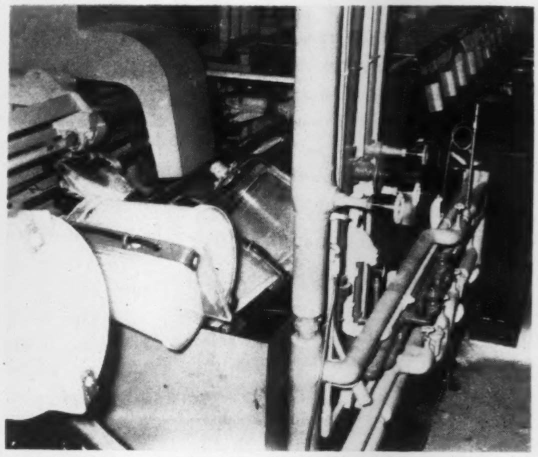


SOUTH HALF of plating room pictured above. Hood at right exhausts curved end of automatic chrome rack machine. Manual plating lines are in background

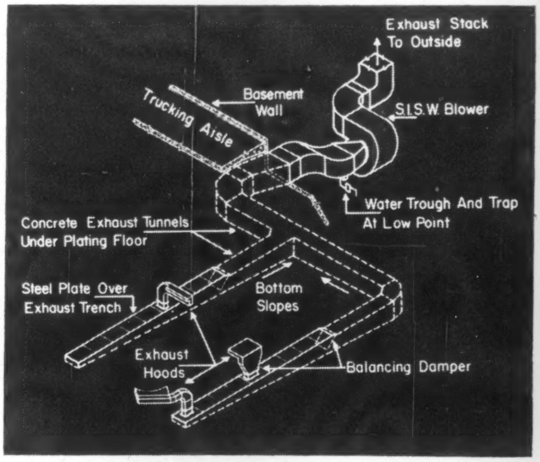
SPOT COOLER in upper left keeps operator station cool. Note how exhaust hoods encase area above high temperature zones



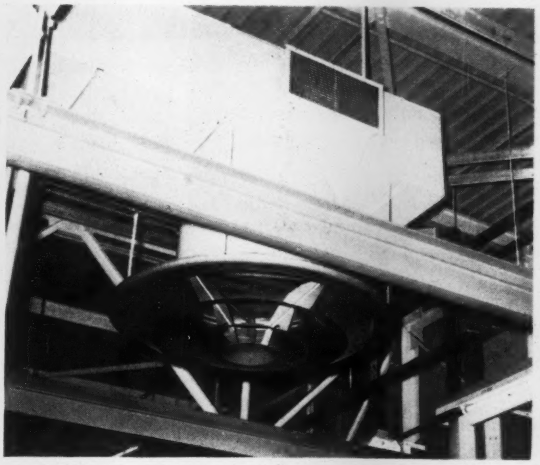
EXHAUST HOODS for manual aluminum anodizing line are in foreground. Note proportionally spaced splitters within hoods



CANOPY was required to provide most economical fume exhaust of wide tanks of this automatic cadmium barrel plating machine


Exhaust Stack To Outside
Basement Wall
Trucking Aisle
S.I.S.W. Blower
Water Trough And Trap At Low Point
Concrete Exhaust Tunnels Under Plating Floor
Steel Plate Over Exhaust Trench
Bottom Slopes
Exhaust Hoods
Balancing Damper

UNDERFLOOR exhaust system conducts air to basement blowers. Note continuous slope of tunnels to moisture trap



SUPPLY AIR must be delivered without causing drafts. Part enters by circular diffusers, rest by duct outlets toward the operator at each work bench and 700 cfm is discharged toward the operator stations in high heat areas. The spot coolers are Navy Type E terminals, and are located 10 ft off the floor.

An adjustable swivel joint has proven to be a satisfactory means of allowing operators to control discharge direction. Volume damper blades are bolted to keep operators from disrupting system balance. This means of adjustment was originally very convenient. To correct this problem, the damper should be located as high above the floor as is practical.

Special effort was devoted to locating air outlets in a manner that would direct the supply air down into the working area without causing uncontrolled drafts. This is necessary in a heat treating area to oppose the rising hot air currents and to cool occupied areas and not just the ceiling.

## Study Plating Exhaust Design

The ventilation design of the plating department was approached by finding the required exhaust volume and then providing the supply air to replace it. A number of books and manuals were included in our research to determine design criteria for plating exhaust volumes.

The data contained in the American Standards Association Code Z9.1 seems to best consider the logical variations in ventilating requirements. Using this criteria, with only a few exceptions, the required exhaust volume for the plating area was calculated to be 250,000 cfm.

While this volume seems, at first glance, to be excessively large, it must be recognized that well over 100 tanks are exhausted. During final balancing operations, design exhaust volumes were experimentally reduced with the conclusion that the original design criteria are a minimum to prevent considerable vapor escape. Many of the rule-of-thumb recommendations found in the literature on the subject and used by plating equipment manufacturers produced considerably higher total exhausts than did the ASA Code.

Although the exact recommendations of the ASA Code Z9.1 could be used without serious trouble, the following changes were successful enough in this design to warrant consideration by others.

1) The capture velocity for 200 F hot water tanks was changed from the recommended 75 fpm to 100 fpm. This was considered desirable to reduce the humidity added to the room because of the 75 F WB summer design condition.

2) The large cadmium automatic barrel and rack plating tanks were ventilated, although this was not specifically recommended. A very offensive odor has been noticed when the hoods on these tanks have been blocked by cadmium salt deposits. Ventilation of these tanks at a minimum rate is considered justified.

3) The bright nickel tanks are air agitated and operated at 140 F. A small tank of this type used in a manual tank line is not ventilated. The fumes and spray from this tank have coated all surrounding surfaces. This coating is not important in the vicinity of the manual tank, but a similar large tank on an automatic machine is successfully ventilated at a minimum rate to protect the many working parts of the machine from corrosion and fouling.

## Exhaust Hood Designs

Exhaust hood designs are modified versions of the hoods recommended in the *Industrial Ventilation Manual*[1].

Proportionately spaced splitter dampers are used on end takeoff hoods. In operation, these hoods have worked very well to produce uniform slot velocities. The design criteria used set maximum slot velocity at 2000 fpm, minimum slot width at 2 in., and maximum slot length at 6 ft.

All hoods are designed to discharge into underfloor concrete tunnels. Velocities at the floor entrance to these tunnels are set for 2000 fpm to minimize the size of openings in the steel plates over the tunnels. Static loss within the hoods in design and practice worked out to be approximately 1 in. water gage. This high loss made balancing of the system rather easy, since loss in the ducts is not significant.

Two of the automatic plating machines have tanks 42 in. wide which create an exhaust problem. A pull of 36 in. is usually considered to be the maximum for maintenance of significant capture velocities. The problem was solved by a canopy over the tanks.

Nearly all the air must be pulled across the entire width of the tanks, since the major open space is in the center of the machine. Volumetric requirements are reduced because of the higher efficiency, fewer hoods are needed, and corrosion of interior parts is reduced. The top and front panels of the canopy are easily removable for access to the machine interior.

## Prevent Residue Fallout

One of the major problems encountered in exhaust of plating fumes is the prevention of fallout of acid residue after the fumes are exhausted from the building. This is usually done by removing acid residue in a fume washer prior to exhausting the air.

In the several IBM plants visited during the design phase of this project it was found that the only fallout ever detected is chromic acid. This enters exhaust ducts primarily as a spray from electroplating. Although mist suppressants are used, some spray can still be detected above the plating tanks. Theoretically, these moisture droplets should fall out of the air stream when air velocity is reduced below 1000 fpm. Therefore, on this job, the collection ducts into which the tank hoods discharge are designed to keep velocities under 1000 fpm.

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[1] *Industrial Ventilation Manual.* American Council of Governmental Industrial Hygienists. Committee on Industrial Ventilation, P. O. Box 453, Lansing, Mich.

The ducts are sloped toward the suction of the exhaust blower. A carefully designed moisture trap is placed in the bottom of the ducts to to remove moisture that has fallen from the air stream. Then, as a further insurance, the velocity in the exhaust stacks is raised to discharge the air vertically at a velocity of about 3000 fpm.

This system has been successful in preventing fallout of harmful plating wastes without using fume washers. By elimination of the fume washers, plant investment, maintenance, and the load on the waste treatment plant have all been reduced.

## Control Hood, Duct Corrosion

Another major problem was corrosion control. The hoods used on this job are made of plastic dipped 16 gage perforated steel. The perforations serve to bind the plastic coating to the hood. This material is highly satisfactory with one exception; the liquid plastic used has an inherent characteristic of running after dipping to form ridges which are hardened by a baking process.

Another possibly negative factor is the restriction on colors in which the plastic was available. If the job were done again, more serious consideration would be given to the possible use of reinforced glass fiber for the hoods. Polyvinyl chloride hoods were considered too fragile.

Underfloor concrete ducts and galvanized ductwork in the basement have been coated with a special epoxy tar compound. This material is also used on all plating floor surfaces exposed to plating wastes. It is low in cost and has given excellent service. Plating tank exteriors are painted with a special three-coat vinyl paint series. All piping and other building surfaces have been painted with standard products which show no sign of failure. This fact must be attributed to the high rate of building ventilation.

## Use 100 Percent Outside Air

Four supply units introduce 62,500 cfm each of 100 percent outside air—sufficient volume to change all air in the plating room once every 2 minutes. The units operate 24 hours a day, seven days a week, but supply air is reduced to match a 50 percent reduction in exhaust air when the plating tanks are not heated.

The length, and thus cost, of d-c bus bar runs have been reduced by placing 36 germanium rectifiers near the plating tanks. Each rectifier has an internal blower to force air over the germanium wafers. If the units had been placed in a separate room or in a basement, special ventilation air would be required for cooling. Since the rectifiers are in the well-ventilated plating room, this problem is eliminated.

## Drafts Cannot Be Tolerated

Distributing the 250,000 cfm of air without causing drafts at the plating tanks is very important. If supply air blows across the tanks, the tank exhaust patterns will be distrubed. To avoid this problem, fixed cone circular diffusers passing 8000 to 9000 cfm each are placed on 30 ft centers throughout the department. The remainder of the total quantity of air supplied to the room is released in the space above the diffusers by duct registers. Most of this air is released in the vicinity of the rectifiers as insurance against overheating.

Because of the large quantity of air supplied to the room, supply air temperatures never vary from room temperatures by more than 2 F. The rapid rate of air change makes rapid response to temperature essential. Satisfactory control has been achieved by use of an electronic-pneumatic system. No attempt has been made to cool the air supplied to the plating department.

Intake dampers on one of the supply air blower intakes are controlled by a differential pressure controller. It is necessary to keep the room at only a slight negative pressure in relation to adjoining manufacturing buildings to prevent high velocity drafts through connecting door openings. Connecting doors also prevent the latent load of the plating room from mixing with the sensible load of the heat treating room. The latent load in the plating room is the result of the heated tanks.

No recorded accounts of the approach to many of the design problems of this job could be found. Thus, assumptions and theoretical solutions were often used without the knowledge that similar solutions had been used sucessfully elsewhere.

The heat treating department started production in May 1958, and the plating department began operations four months later. Sufficient data has been gathered in the interim period to justify the conclusion that the designs have been successful and should be reused in similar situations.

The author appreciates the support and cooperation of R. B. Morris, Jr., plant engineer, and the other IBM employees who contributed to the success of the project. Employees of Utility Sales and Engineering Co., Inc., ventilation contractors for the building, were able and cooperative in working with design details; W. A. Swenberg, principal owner of the firm, was particularly helpful by discussing and supporting design decisions. ‡

# Self-Contained Units Heat, Cool New Office Building

## *. . .to meet year 'round comfort requirements*

- Service to individual tenants
- Sound investment in rental property
- Low first cost
- Low owning and operating costs

**Insurance companies make few mistakes in the investment market. When they spend money they know where it is going. When they build rental space they are confident of a good return on their investment. Such has been the case in Boston with the construction of a 16-story office building by the Travelers Insurance Companies. Service to tenants was given the utmost importance in building design—with year 'round air conditioning being a major consideration. What kind of air conditioning system did Travelers install? This article will explain its design and tell why it was selected.**

By LEWIS SMITH
Heating Engineer

CONSTRUCTION and ownership of commercial office buildings by insurance companies is definitely more investment than speculation, although the element of risk is always present. Therefore, owning and operating costs and tenant satisfaction with building air conditioning are more carefully scrutinized than is customary in the building industry. So, when the Travelers Insurance Companies of Hartford, Conn., put up an office building in Boston, with most of the space to be rented to others, it is of unusual interest to see what kind of an air conditioning system was installed and why.

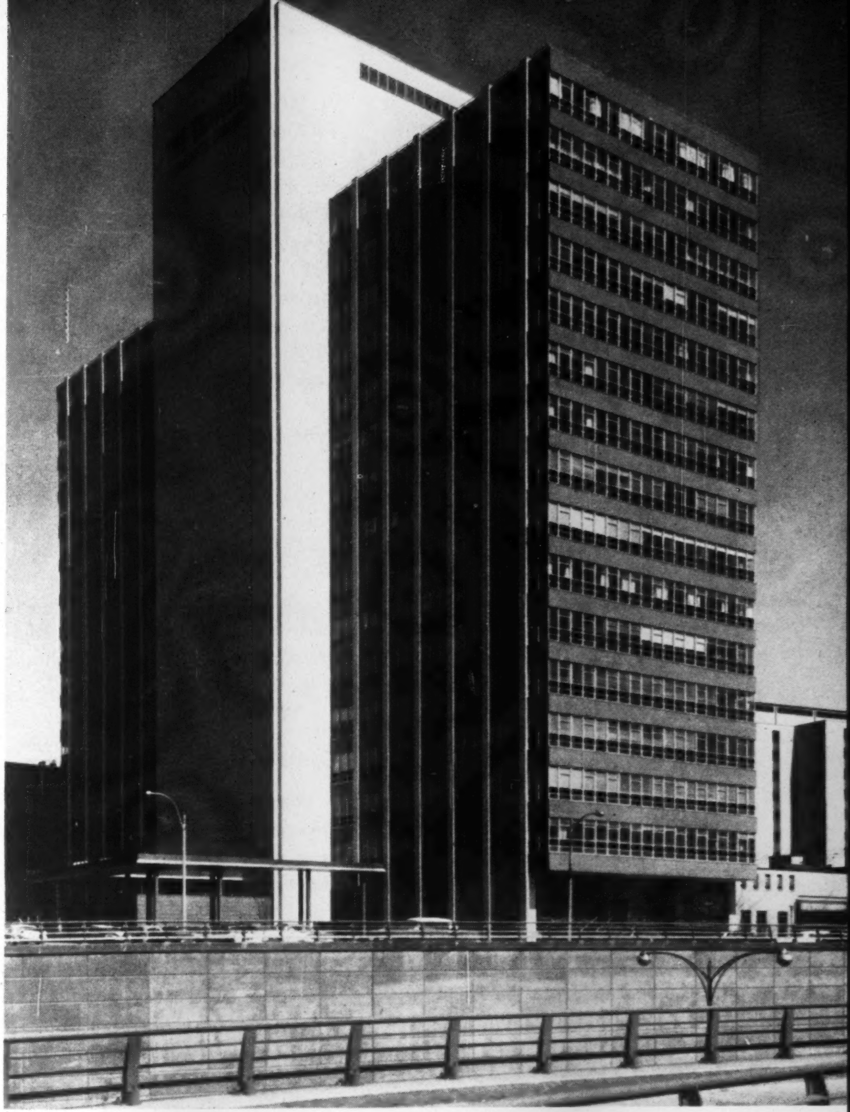
This building is 16 stories high, measuring 70 × 231 ft except for a projecting part in the center for elevators and service spaces. It was first opened in July 1959 and is one of the land marks of the city, replacing several buildings some of which were over 150 years old. It contains 260,000 sq ft of rentable area and four floors are occupied by Travelers.

Since the building will carry the name and hence the reputation of the insurance company it was important to give superior service, at the same time making sure that the owning and operating costs as well as the reliability of the equipment would fully safeguard the integrity of the investment while allowing for the maintenance of a competitive rental schedule. It might be added that the Boston climate is notorious for its sudden and wide temperature changes due to its proximity to the cold waters of Massachusetts Bay. These "sea turns" can produce a situation where the summer air temperature makes some heat desirable while the sun effect calls for cooling.

Based on experience in other buildings the owners felt it was most desirable that both heating and cooling should be available to the tenants at all times during working hours. It was suggested that this objective might be more closely approached at no greater cost and perhaps less cost than by any central system through the use of individual heating-cooling units in each room or space.

Studies were undertaken of available equipment. This lead to an investigation of small self-contained condensing units with heating coils. These are placed under windows and in perimeter walls.

Such units, often referred to as "through-the-wall," are not new, having been commonly used in recent years to provide low cost cooling (on tenants' meters) in apartment houses and existing buildings. In the case of the Travelers job, however, it was not merely first cost that attracted attention: service to tenants was the primary consideration. This is believed to be the first large office building



BOSTON'S new Travelers Insurance Companies building encloses 16 stories of year 'round air conditioned floor space

erected with such units incorporated in the original structure.

Quiet operation is most important. These units have frequently been found to be objectionably noisy and the insurance company itself has had some experiences with even central systems which made them anxious on this point. Therefore the consulting engineers said that noise criterion curve NC 35 described in the Guide must be the upper limit and required that the unit finally selected should be noise tested before acceptance.

Finally, it was stipulated that if such units were to be used, they must be constructed not only for an acceptable life expectancy, but in such a way that any parts which might require replacement would be easily accessible and removable. Particular attention was paid to parts exposed to outside air and moisture for which aluminum and stainless steel were specified.

Preliminary estimates prepared by the consulting engineers indicated that in this particular building the overall cost of a system using such specially designed units should be lower than for a central system complete with automatic individual room temperature control, cooling tower, etc. The builder reports that the bids substantiated this prediction.

The electrical contract, which included a special remote control system for the units, was reported to be less rather than more as expected for this type of building. Another favorable factor was a net saving in floor space due to the absence of risers along columns.

The unit finally selected was designed in cooperation with the architect, builder, and consulting engineer. With 745 identical units, a custom built unit could be had at nominal cost. These units are rated under standard conditions for cooling at 11,500 Btu per hr and for heating at 17,000 Btu per hr with entering water at 200 F and a temperature drop of 30 F.

Building columns are on 24 ft centers with an intermediate pilaster. Units are housed with recesses extending under the three windows forming each 12 ft bay. One unit serves each bay. It is normally located under the center window, but it may equally well be placed under or moved to one of the other two windows if partitioning should should make this desirable.

Sixty of the units are for heating only and are placed in corner rooms with high heat losses. Aluminum louvered grilles are provided on the exterior walls for the necessary air openings. For the sake of appearance as well as convenience if units are relocated, a grille was placed under every window. Those not in use are blanked off.

The unit consists of four major components: (1) an outside air louver, (2) a wall box, (3) a heating section, and (4) a cooling chassis assembled on the job in a continuous enclosure, all joints being made moisture and water proof with flanges and gaskets.

The wall box, made of stainless steel, has the bottom sloped toward the outside. A projecting lip keeps water, which gets into the unit, from dripping down the outside wall of the building.

The heating section consists of a finned coil for hot water and two double-inlet centrifugal blowers direct-connected to a 115 watt single-phase capacitor motor operating at 1090 rpm to provide 320 cfm through both the evaporator coil (when wet) and the heating coil, 60 cfm being outside air for ventilation.

The cooling chassis comprises a hermetic compressor with a three-phase, 208-volt, 1¼ hp, motor (three-phase motors were selected as being quieter, more efficient, and more reliable than single phase), evaporator coil, and condenser coil with blower type fan driven at 970 rpm by a 1/6 hp capacitor motor. The whole chassis was constructed as a removable assembly.

Condensate from the evaporator coil is handled by having the condenser blower vaporize it and blow it over the hot surface of the condenser coil to the outdoors.

The condenser blower is arranged so that it delivers outdoor air through the filter into the evaporator blower. These two blowers run continuously during hours of occupancy, providing a constant air movement and positive filtered ventilation air for each office space on the perimeter of the building. The outdoor air intake is provided with a solenoid operated damper arranged to be closed when the power is cut off the unit as a safeguard against freezing the heating coil and also to prevent needless cooling at night.

Power to the units is turned on and off from a central point. When it is turned on in the morning, both blowers start running and continue to run until it is cut off in the evening. The outdoor air damper is also opened.

A double-acting thermostat in the room air entering the unit controls both heating and cooling. A knob is provided for the tenant to select his own temperature. If the room temperature rises above that for which the thermostat is set by this knob, the compressor runs as necessary for cooling. If the room temperature falls, the motorized modulating valve in the inlet to the heating coil opens to admit hot water as required. When the thermostat is satisfied, only the blowers run for ventilation. A concealed switch is provided so that the building superintendent can cut off the compressor in the mid-winter months to prevent needless operation.

### Control Panel on Each Floor

The units on each floor are electrically connected in four groups to a central panel in a closet on each floor. All these panels are then connected to a master panel in the basement. Since most tenants occupy at least a quarter of a floor, it is easily possible to have only the units in one tenant space running when overtime occupancy is needed. Otherwise, all units are cut off from the central panel at night and over weekends.

However, the motorized valve is on a separate 24-volt circuit which is never cut off and the valve remains under thermostatic control, so that even with the fans shut down, if the circulating pump is left running, there is enough gravity heat given off by the units to maintain safe night time temperatures during the winter months.

### Protect Coils from Freezing

To guard against frosting of the evaporator coil if the air flow should be blocked in some way, a freezestat is located between the evaporator and heating coils to shut down the compressor and condenser blower on low temperature. The same action closes the outdoor air damper to protect the heating coil from freezing.

Hot water piping is not zoned since each unit is individually controlled. Its temperature is, however, controlled in the usual way in step with the weather. District steam is supplied to a converter by the Boston Edison Co. This takes care of the perimeter of the building.

### Two Systems Handle Interior

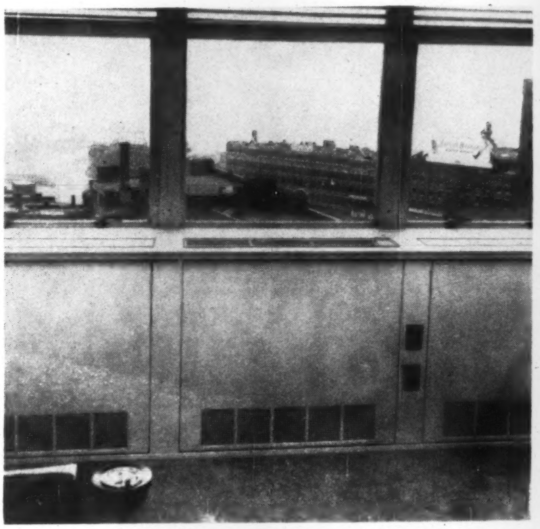
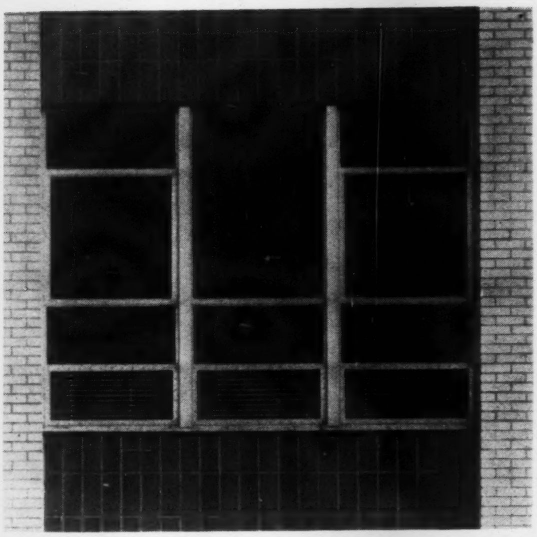
For the interior spaces, two separate air handling systems of conventional design are used. Two sets of supply and return fans are on the roof, one set for the second to ninth floors, the other for the 10th to 16th floors, controlled from the return air for a fairly uniform and constant outlet temperature.

Supply ducts are hung in ceilings, which serve as plenums for return air. The first and second floors have separate air conditioning systems arranged according to occupancy. A 480-ton absorption unit served by the Edison steam lines is located on the roof to take care of the interior system.

### Evaluate Operating Costs

Operating costs? On the heating cycle there can be no question as to the economy of this centrally controlled hot water system with individual room control. Running the two blowers on each unit continuously for outdoor air should be not much different from a central system if all factors, including friction losses, are considered.

On the cooling cycle (in Boston this is the shorter of the two cycles) comparison with a central system is more difficult to make. A lot of small compressors with air cooled condensers naturally take more power than a large cen-



**TYPICAL INSTALLATION**, inside and out, shown above. Only one louver is normally used; others are blanked off but are available for alternate locations of air conditioning equipment

tral compressor with a water cooled condenser. But, on the other hand, a central system requires condenser and chilled water pumps and cooling tower fans. This should more than make up the difference in compressor horsepower.

While it cannot be definitely known in advance what the hours of operation of each compressor will be (since this is partially under the control of the tenant), nevertheless it is logical to believe that the annual power cost will be less than for a central system. Two reasons for this thinking are:

1) When a room thermostat is satisfied, the compressor it controls stops completely. With a central system, the compressors, even when two are provided to split the load, would be running at less than maximum efficiency a good deal of the time.

2) The various pumps and fans of a central system run continuously at practically full power.

There is also the cost of make-up water which is nil with the unit system. But sufficient time has not yet elapsed to ascertain the actual operating cost of the Travelers job.

As to life of the equipment, the critical factors are corrosion and damage from moisture to compressors, motors, and blowers. With all metal parts that are exposed to moisture or the weather made of stainless steel or treated aluminum, and electrical parts specially waterproofed, damage from this source will be held to a minimum, and a life of at least 15 years is expected.

It is anticipated that the compressors will operate only some 400 to 600 hr per year. The manufacturers of such equipment state that the average life is at least 40,000 hr, so for this job there would seem to be no question about using a 20-year life. Blowers and their motors are generally expected to last at least 15 years, so on the whole the life expectancy of 15 years used by the consulting engineers in establishing the owning cost would seem to be well on the conservative side and on a par with the central systems.

Replacing or cleaning of filters is inherent to all systems. But on this job the introduction of outdoor air through each filter may necessitate slightly more frequent servicing. Obviously, there will be some replacement of parts every year. But, as explained earlier, the units have been arranged so that this can be done quite easily (although it may not always be quite so simple to get at the units in occupied spaces). The actual annual maintenance cost can be determined only by experience.

### Not Much Cost Difference

Taking into consideration the repairs and periodic overhauling of a large central compressor and associated pumps and cooling tower and fans, the owning cost of the two systems would not appear to be greatly different. Much will depend on how well the preventive maintenance program is carried out.

The motors driving the blowers are of the permanently oiled type but, as a precaution, oiling tubes are provided and oiling once in three years is suggested by the manufacturer of the units.

Kahn & Jacobs were the architects. The consulting mechanical engineers were Jaros, Baum & Bolles. John Ventura Co. was the mechanical (heating, piping, and air conditioning) contractor. ‡

*Photos courtesy Remington Air Conditioning Div., Remington Corp., and Geo. A. Fuller Co.*

# NDHA Committees Report What's New

**Nine technical committees report association progress at 51st annual convention. Among the reports:**

- ***Remote controls lower manpower requirements***
- ***Philadelphia builds peak-load steam plant***
- ***Seattle reverses profit picture to show gain***

By JOHN F. COLLINS, JR.
Secretary-Treasurer
National District Heating
Association

AT THE recent 51st annual meeting of the National District Heating Association, nine technical committees of the organization reported the progress being made on investigations of many phases of district heating. The meeting was held in Asheville, N.C. (A previous report on the meeting appeared in the August issue.)

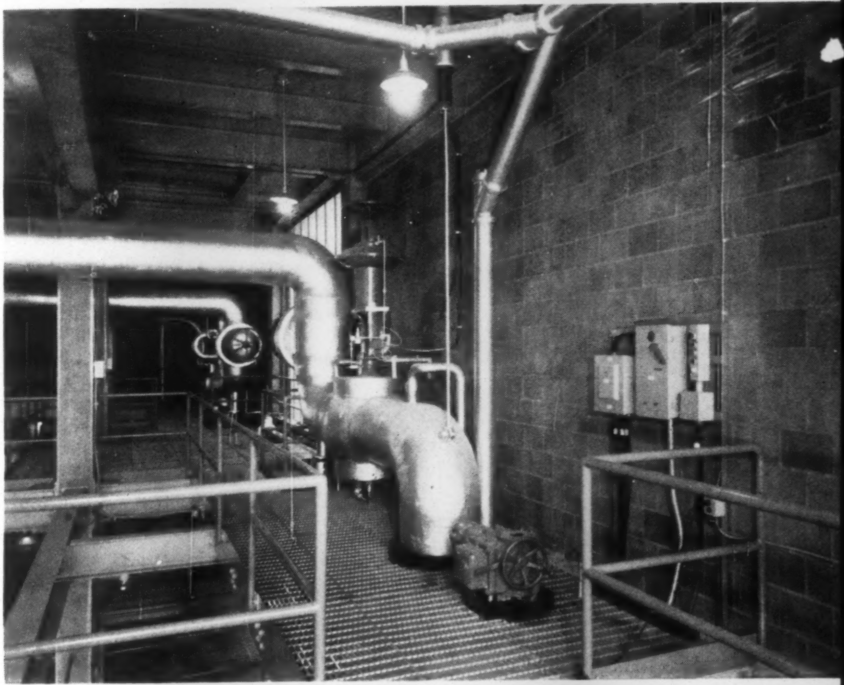
Included in the report of the steam station committee, whose chairman is Charles E. Richards, assistant general superintendent, steam power division, The Cleveland Electric Illuminating Co., were three technical papers.

### Study Manpower Needs

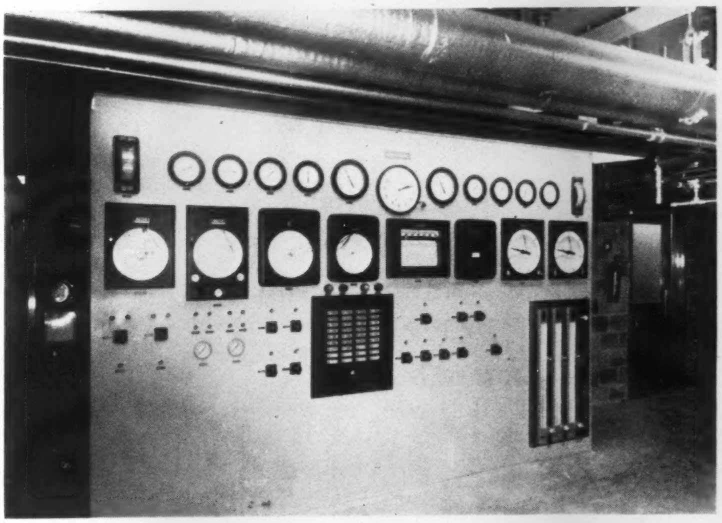
In the first of these, Donald H. Brandt, general steam heating supervisor, Consumers Power Co., which services five Michigan cities, reported the results of his inquiry into "manpower requirements" by steam suppliers.

He said all were in agreement that the personnel charged with management, operation, and

NEW PHILADELPHIA PLANT control valves shown at right. One serves each of two lines leaving plant. These 16 in. valves maintain 175 psi at all times so that plant can always operate at maximum capacity — even at times of heavy load



CONTROL BOARD IN Philadelphia plant is located at end of firing aisle. Gages, indicators immediately reflect operating conditions throughout plant



maintenance of district steam properties can do little to combat the ever-increasing percentage of the income dollar that goes each year for insurance, interest, depreciation and amortization, and general taxes and federal income taxes. However, a constant vigilance is demanded, he said, to eliminate or reduce to a minimum any or all factors contributing to increased expenses for operating and maintenance.

The report shows that at least a dozen utilities have successfully taken definite steps to defer the annual increase in operating and maintenance expense through more effective utilization of manpower. Some of the methods used were reported, among them:

1) Substitution of a remote control for automatic feed water regulations on a boiler operating panel of a large capacity boiler eliminated the equivalent of 8.4 men employed as water tenders.

2) Installation of a remote control for operating a desuperheater and pressure regulating

station on an outgoing steam line at a central regulating station. It is estimated that this will eliminate the equivalent of 4.2 men employed to regulate.

3) Addition of a single 150,000 lb per hr boiler, with automatic combustion control in a plant having two 75,000 lb per hr generators, resulted in operation of a plant with double the capacity with no manpower increase. In a similar move, capacity was tripled with no additional labor.

Mr. Brandt described an installation containing two 215,000 lb per hr steam boilers with two additional planned for the future where only two operators per shift and one day-shift supervisor are required. He also described improvements made at three other locations which resulted in savings of substantial amounts of money.

Economic gains, he explained, were attained by some utilities by enlarging the scope of their duties when the installation of automatic controls made this possible.

Finally, Mr. Brandt summarized outstanding changes on four systems. On one, for example, the replacing of 25 old chain grate stoker-fired boilers with a capacity of 675,000 lb per hr of steam with five large chain grate stoker-fired units with a somewhat larger total capacity and the addition of automatic control equipment permitted a reduction in manpower at this station from 75 to 48. The extra men were transferred to a new plant.

### Philadelphia Adds Plant

In the second presentation of the steam station committee, Bently Harper, engineer with the Philadelphia Electric Co., described the new Edison steam plant, its equipment, and its operation. The installation is one of four steam stations supplying service to downtown Philadelphia.

The peak-load steam plant was built when a preliminary study showed that the load on the system was approaching the point where there would not be enough reserve capacity in the coldest weather.

Placing the new station in the heart of the office building and shopping area made it necessary to take particular care with its architecture. To avoid bad stack emission, tests were made in the wind tunnel of the University of Michigan on a model having a scale of 1 to 300. This model represented all buildings within 2100 ft of the plant. The stack, triangular in horizontal cross-section, is concealed in a structure of steel and concrete, surrounded by brick.

The first two boilers (of four to be installed eventually) are steam generating units with two drums each and vertical tubes. Furnaces are completely water cooled. Continuous capacity of each is 216,000 lb per hr. Steam conditions are 190 psi and 460 F. Oil fired, completely water cooled furnaces make it possible to have the plant in operation within three hours when the demand is present.

No. 2 oil is used for lighting off the boilers and No. 6 for generation. Each unit is equipped with six steam-atomizing circular oil burners. They have mechanical fly ash collectors. Automatic and remote manual controls are used wherever possible to keep manpower requirements to a minimum.

All forced and induced draft fans and boiler feed pumps are steam turbine driven and the exhaust is used to heat the feed water. The exhaust header is equipped with a relief valve and pressure reducing valve from the live steam header to maintain the 3 psi required by the heaters. There are two vertical, open deaerating heaters, each capable of heating 900,000 lb of water per hr to 212 F. These heaters are stainless steel clad and equipped so that the feed water can be chemically treated in the heaters if it is found necessary to do so.

The cost of the present plant with auxiliaries for two additional future boilers was $4.3 million, or $11.80 per lb of steam net. It is expected that when the entire plant is completed in the future, this figure will drop to $8.00.

### Seattle Reverses Trend

Richard McKay, executive vice president, Seattle Steam Corporation, described the steam generator program serving his far western city. He said that since his company acquired in December 1951 the central heating system from Puget Sound Power & Light Co., the new management has been able to change the earning position from a substantial annual loss to a satisfactory gain.

This has been accomplished by improvements to steam generating facilities to give good overall efficiency by installation of one large efficient unit, coupled with low capital investment by transferring old units to standby. It includes a proposal to supplement peak and standby capacity with a package unit which, with the foundation available, becomes relatively low cost.

Labor was cut in half by the abandonment of obsolete coal equipment and by decreasing personnel on shifts.

In the final paper on the steam station committee program, H. T. Rutkowski and R. G. Schuerger, respectively chemist and general supervising engineer in the test section of the mechanical engineering department of The Cleveland Electric Illuminating Co., explained their method of coal evaluation to appraise the relative worth of delivered coals. By the use of properly selected construction factors, the undesirable effects of moisture, ash, and sulfur are recognized and evaluated.

Further technical reports — air conditioning, campus heating, commercial relations, sales development, research, metering, and distribution — will be discussed in an early issue. ‡

# New Alignment Chart Estimates Density, Velocity Head, Velocity

By RICHARD S. BRIEF
Medical Research Div.
Esso Research and Engineering Co.

THE ALIGNMENT CHART on the next page combines two alignment charts in one. The first estimates density from temperature, pressure, and specific gravity data. The second utilizes density data and velocity head to obtain velocity, or obtains velocity head from density and velocity information. The equations solved are:

$$D = 1.325\ (GP/T) \quad \text{[1]}$$

$$H = 8.31 \times 10^{-7}\ DV^2 \quad \text{[2]}$$

$$V = 9.52 \times 10^{+2}\sqrt{TH/GP} \quad \text{[3]}$$

*where*:

$T$ = gas absolute temperature, R (R = 460 + F)
$P$ = absolute pressure of gas, in. Hg
$G$ = specific gravity of gas relative to dry air
$H$ = velocity head, in. WG
$V$ = velocity, fpm
$D$ = density of gas, lb per cu ft

The following examples will show the uses of the alignment chart.

## Example 1:

*Problem*: What is the density of methane at 27 in. Hg and 720 R?

*Solution*: On the alignment chart, connect 27 in. Hg on the pressure scale with 720 R on the temperature scale (line No. 1). At the intersection of this line with the *PT* pivot line, draw another line (No. 2) to 0.552 on the specific gravity scale. The specific gravity (relative to air) of methane is the ratio of the molecular weight of methane to air, or 16/29 = 0.552. This second line intersects the density scale at 0.0274 lb per cu ft, the density of methane at the stated conditions.

## Example 2:

*Problem*: What is the velocity head of the gas described in Example 1 when it is flowing at 4000 fpm?

*Solution*: By connecting the density scale at 0.0274 lb per cu ft with 4000 fpm on the velocity scale (line No. 3), the velocity head is read as 0.364 in. WG on the velocity head scale.

## Example 3:

*Problem*: A pitot tube is inserted in a stack and a velocity head of 0.5 in. WG is obtained. From an Orsat analysis, the gas flowing is found to have the following volumetric composition on a dry basis: 12 percent $CO_2$, 1 percent CO, 79 percent $N_2$, and 8 percent $O_2$. The temperature in the stack is 440 F (900 R), and the absolute pressure is 31 in. Hg. The moisture content is 0.2 lb of water per lb of dry gas. What is the velocity of the gas?

*Solution*: The specific gravity of the gas is determined by preparing a simple chart as follows:

| Component | Volumetric fraction (dry basis) | × | Molecular weight | = | Weight fraction (dry basis) |
|---|---|---|---|---|---|
| $CO_2$ | 0.12 | × | 44 | = | 5.28 |
| CO | 0.01 | × | 28 | = | 0.28 |
| $O_2$ | 0.08 | × | 32 | = | 2.56 |
| $N_2$ | 0.79 | × | 28 | = | 22.12 |
| $M$ = Average dry gas molecular weight | | | | = | 30.24 |

To account for the moisture in the gas, the following formula is now applied:

Specific gravity (relative to dry air or gas) =

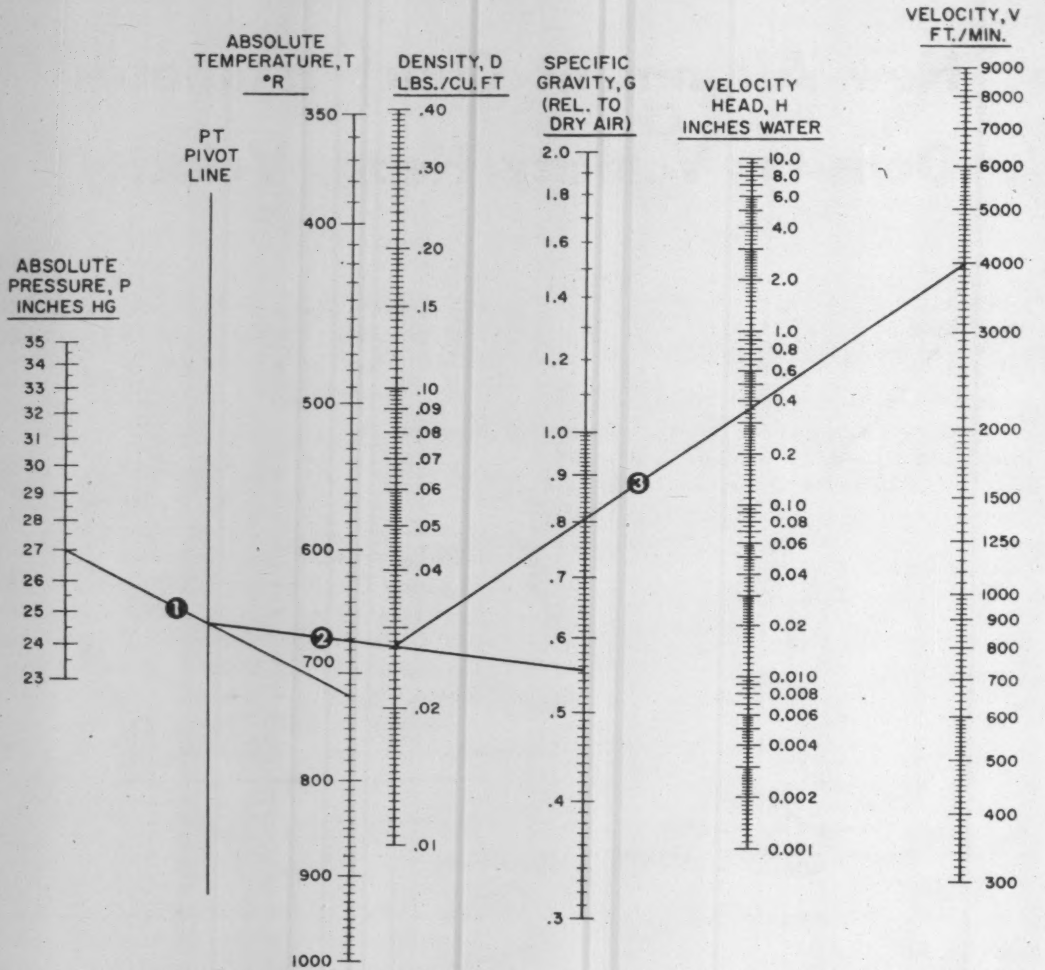
$$G = [[0.62M\ (W + 1)]/[18 + MW]] = [[0.62(30.24)(1.20)]/[18 + (30.24)\ (0.20)]] = 0.936$$

On the alignment chart, connect 31 in. Hg on the pressure scale with 900 R on the temperature scale. Connect the intersection on the *PT* pivot line with 0.936 on the specific gravity scale. This gives a density of 0.0427 lb per cu ft. Connecting this density with 0.5 in. WG on the velocity head scale gives the answer, 3750 fpm on the velocity scale.

## Example 4:

*Problem*: Air in a ventilating duct at 70 F and 29.92 in. Hg (density = 0.075 lb per cu ft) is flowing at a velocity of 2000 fpm. What is the velocity head corresponding to this flow?

*Solution*: Connect 0.075 lb per cu ft on the density scale with 2000 fpm on the velocity scale.



**ALIGNMENT CHART** combines two charts in one; lets you quickly estimate density, velocity head, velocity. See page 123 for instructions. Lines 1, 2, and 3 plot Examples 1 and 2

The intersection of this line with the velocity head scale gives the answer, 0.25 in. WG.

**Example 5:**

*Problem*: Air velocity at the center line of a round duct was determined with a pitot tube. The measurement location was preceded by 10 diam of straight duct. A velocity head reading of 1.0 in. WG was obtained. Assuming that the air has a density of 0.075 lb per cu ft, what is the average velocity in the duct?

*Solution*: Since there is a sufficient length of straight duct ahead of the pitot tube (i.e., 10 diam), the average velocity can be estimated by multiplying the center line velocity head by 0.81 or the center line velocity by 0.90. In the first case, multiply 1.0 in. WG velocity head by 0.81 to get an "average" velocity head. By connecting 0.81 in. WG on the velocity head scale with 0.075 lb per cu ft on the density scale, the resultant line intersects the velocity scale at 3600 fpm, the estimated average velocity. In the second case, connect 1.0 in. WG on the velocity head scale with 0.075 lb per cu ft on the density scale. This gives on the velocity scale a value of 4000 fpm center line velocity. Multiplication of this velocity by 0.90 gives the average duct velocity of 3600 fpm. ⌗

### HOW TEMPERATURE, TREATMENT, AND VELOCITY OF POTABLE WATER AFFECT CORROSION OF COPPER AND ITS ALLOYS

# Cupro-Nickel, Admiralty Tubes Resist Corrosion Better

**●** **Among the tests conducted at Michigan State University to study the effects of various temperatures, qualities, and velocities of potable water on the corrosion of copper and copper alloys were pilot plant studies using sodium-zeolite softened water with copper, red brass, cupro-nickel, and admiralty brass tubes. Results of these tests clearly indicate that:**

**1) 90/10 cupro-nickel offers excellent corrosion resistance to sodium-zeolite softened water containing oxygen and carbon dioxide in all temperature and velocity ranges tested.**

**2) Admiralty tube shows excellent corrosion resistance to sodium-zeolite softened water containing oxygen and carbon dioxide at all temperatures up to 170 F for velocities up to 13.1 fps and for temperatures up to 200 F at velocities below 8 fps.**

**3) 90/10 cupro-nickel and admiralty tubes offer reasonable corrosion resistance for use as heat exchanger tubing when using aggressive sodium-zeolite softened water containing carbon dioxide and oxygen where designed usages call for high velocities and high temperatures and if water quality cannot be improved to protect copper or other copper based alloys.**

**4) 90/10 cupro-nickel and admiralty brass exhibit remarkably better corrosion resistance to an aggressive sodium-zeolite softened water than copper and red brass. (Admiralty brass is about 5 percent more expensive and 90/10 cupro-nickel is about 65 percent more expensive.)**

By MALVERN F. OBRECHT
Water Treatment Consultant
and Professor of Chemical Engineering, and
LAURENCE L. QUILL
Head, Department of Chemistry
Michigan State University

IN THIS ARTICLE, the results and discussions of pilot plant studies using sodium zeolite softened water with red brass, cupro-nickel and admiralty alloys are reported. Although these three alloys were chosen

*This is the sixth in a series of articles. The first five appeared in the January, March, April, May, and July issues.*

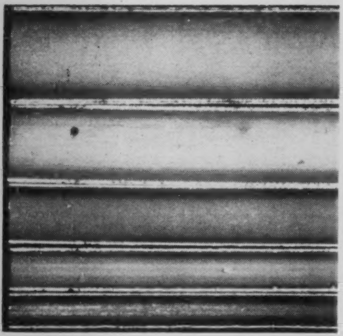


**Fig. 1**—Varying velocities, 110 F

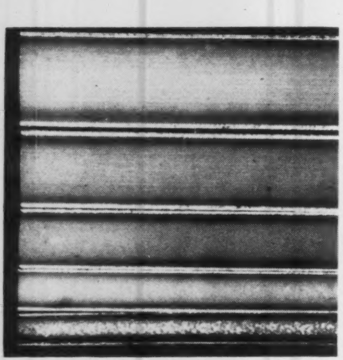


**Fig. 2**—Varying velocities, 140 F

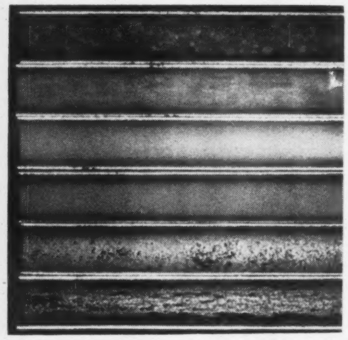


**Fig. 3**—¾ in., varying F, 3.9 fps

**1-5** RED BRASS TUBE used in MTP No. 2 showed these effects after 632 days' exposure to operating conditions given under each photo. Test panel handled sodium zeolite softened water, was strongly attacked at high flow rates

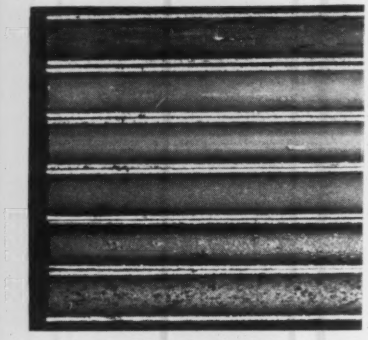


**Fig. 4**—½ in., varying F, 8.1 fps

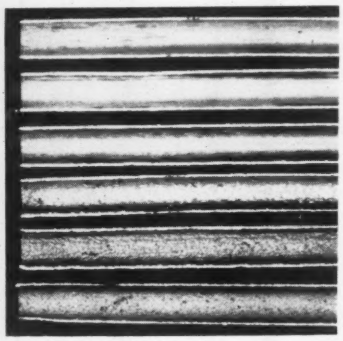


**Fig. 5**—⅜ in., varying F, 13.1 fps

arbitrarily, certain factors and characteristics about them were guide lines for their selection.

It has been generally recognized that it is difficult if not impossible to produce in the laboratory a good prototype of a severely aggressive water and the types of corrosion resulting from such water. The experiences at Michigan State University indicated a type of water ideally suited for accelerated corrosion testing.

To impart desirable properties to copper, the metal is alloyed with zinc, tin, aluminum, iron, silicon, lead, manganese, chromium, nickel, phosphorus, etc. Some of these elements also improve corrosion resistance. These alloys and the methods of fabricating them have been developed to overcome failures due to dezincification, impingement attack, stress corrosion, and corrosion fatigue. Copper and its alloys also show high heat transfer rates.

Alloys widely used for handling various types of industrial and process waters are red brass, arsenical admiralty metal, aluminum brass, cupro-nickel alloys (70/30 and 90/10), arsenical copper, and 88/10/2 alloy (88 percent copper, 10 percent zinc, 2 percent tin). In industrial applications, the alloys are often subjected to high temperatures and high water flow velocities, as well as to waters containing carbon dioxide, oxygen, nitrogen, sulfur compounds, ammonia, sewage, and acidic and alkaline substances. Likewise, they are exposed to waters with salt contents as high as those of sea water. Copper alloys are also used in equipment handling concentrated brine, such as in salt refineries. There are many applications of these copper base alloys to heat exchanger tubing because of their high corrosion resistance and good life expectancy.

The three copper alloys chosen arbitrarily for evaluation of the effects of the aggressive sodium zeolite softened water were red brass, 90/10 cupro-nickel, and admiralty metal. The choice of the latter two was not based on the suggestion that they would be satisfactory or economical for distribution of potable waters, but rather because they are suitable alloys for tubing in heat exchangers and condensers.

Light annealed red brass (85 percent copper, 15 percent zinc) is favored as an alternate to pure copper tube for heat exchangers and for general application in potable water distribution systems. The copper content of red brass is sufficiently high to prevent dezincification under normal service conditions. Although it is reported to be satisfactory for use with fresh potable waters containing moderate amounts of carbon dioxide and oxygen, red brass is not recommended for use with waters containing hydrogen sulfide and other sulfur compounds. The pilot test panel in which the red brass was tested was Main Test Panel No. 2 (MTP No. 2).

Cupro-nickel alloys are reported to have excellent resistance to impingement corrosion and to corrosion at high temperatures. The three cupro-nickel alloys widely used are 70/30 and 90/10. (These may contain up to 2 percent iron.) The 70/30 alloy has been extensively used in naval vessel condensers because it is relatively highly resistant to aerated salt water, polluted harbor waters, sewage and organic matter-contaminated waters.

Cupro-nickel alloys have high ductilities and high strengths even at high temperatures. Thermal conductivities are, however, about one-third that of admiralty metal, which means that additional heat transfer area is needed when the cupro-nickel alloys are used in heat exchangers. Films formed on cupro-nickel are apparently more adherent than on copper or red brass and, if broken during service, tend to reform rapidly.

In MTP No. 7, 90/10 cupro-nickel of nominal composition 88.35 percent copper, 0.40 percent manganese, 1.25 percent iron, and 10 percent nickel was used. Because of the iron content, this alloy reportedly approaches the corrosion resistance of the 70/30 alloy.

The admiralty tubing used in MTP No. 7 had an analyzed composition of 71.0 percent copper, 1.0 percent tin, 0.04 percent arsenic, and 27.96 percent zinc compared to the nominal composition of 71 percent copper, 1 percent tin, about 0.06 percent arsenic, and 28 percent zinc. This alloy resists corrosion by salt, brackish, industrial, or fresh potable waters. It can be used for either slightly acidic or alkaline waters, but not for strong acid or ammonia waters. Dezincification is deterred by the arsenic. It is reported to have limited resistance to impingement corrosion. In petroleum refinery applications, it is used to resist corrosion when waters contaminated by sulfur compounds are used and for heat exchangers handling sour or sweet crudes, cracked products, lubricating oils, and various other petroleum products.

The pilot plant test panels operated for the red brass, cupro-nickel, and admiralty runs were assembled as described in an earlier article in this series, *Monitoring System Reveals Effects of Different Operating Conditions* (April). Red brass was used in MTP No. 2. MTP No. 7 differed from the other panels in that the sample tubes each consisted of one-

**TABLE 1—MAIN TEST PANEL No. 2, red brass tube, handled sodium-zeolite softened water for 21 months. Analysis of corrosion products given below is from 1¼ in. tubes**

| | |
|---|---|
| WATER TEMPERATURE—50 F | |
| *Water-insoluble constituents* | |
| Ferric oxide | large amount, thin, loose, dark brown deposit |
| Silica | small amount, mixed with ferric oxide |
| Carbonates | none |
| Cuprous oxide | large amount, continuous thin coating |
| *Water-soluble constituents* (24 mg per sq ft—small compared to constituents above) | |
| Chlorides | moderately large amount |
| Sulfates | large amount |
| Calcium salts | large amount |
| Copper salts | large amount |
| Sodium salts | large amount |
| Ammonia | trace (0.7 mg per sq ft) |
| Silica | large amount |
| Organic mater | large amount |
| Water washings concentrated to 4.5 ml | pH 5 |
| WATER TEMPERATURE—80 F | |
| *Water-insoluble constituents* | |
| Ferric oxide | large amount, thin, loose, dark brown deposit |
| Silica | small amount, mixed with ferric oxide |
| Carbonates | none |
| Cuprous oxide | large amount, continuous thin coating |
| *Water-soluble constituents* (18 mg per sq ft—small compared to constituents above) | |
| Chlorides | moderately large amount |
| Sulfates | large amount |
| Calcium salts | large amount |
| Copper salts | large amount |
| Sodium salts | large amount |
| Ammonia | trace (0.4 mg per sq ft) |
| Silica | large amount |
| Organic matter | large amount |
| Water washings concentrated to 3.3 ml | pH 5 |
| WATER TEMPERATURE—110 F | |
| *Water-insoluble constituents* | |
| Ferric oxide | large amount, continuous yellow colored coating |
| Silica | small amount, distributed generally |
| Carbonates | none |
| Cuprous oxide | none |
| Cupric oxide | moderately large amount, thin, general film |
| *Water-soluble constituents* (19 mg per sq ft—small compared to constituents above) | |
| Chlorides | moderately large amount |
| Sulfates | large amount |
| Calcium salts | large amount |
| Copper salts | small amount |
| Zinc salts | large amount |
| Sodium salts | slight amount |
| Ammonia | trace (0.3 mg per sq ft) |
| Silica | large amount |
| Organic mater | large amount |
| Water washings concentrated to 3.5 ml | pH 5.5 |
| WATER TEMPERATURE—140 F | |
| *Water-insoluble constituents* | |
| Ferric oxide | large amount, mostly as loose deposit |
| Silica | small amount |
| Carbonates | none |
| Cuprous oxide | none |
| Cupric oxide | moderately large amount |
| *Water-soluble constituents* (13 mg per sq ft—small compared to constituents above) | |
| Chlorides | moderately large amount |
| Sulfates | large amount |
| Calcium salts | large amount |
| Copper salts | small amount |
| Zinc salts | large amount |
| Sodium salts | none |
| Ammonia | trace (0.3 mg per sq ft) |
| Silica | large amount |
| Organic matter | moderately large amount |
| Water washings concentrated to 3.5 ml | pH 5.5 |
| WATER TEMPERATURE—170 F | |
| *Water-Insoluble Constituents* | |
| Ferric oxide | large amount, flaky deposit |
| Silica | large amount |
| Carbonates | none |
| Cuprous oxide | very large amount, broken, patchy deposits |
| Cupric oxide | very large amount, distributed irregularly |
| *Water-Soluble Constituents* (15 mg./sq. ft.—small compared to constituents above) | |
| Chlorides | moderately large amount |
| Sulfates | large amount |
| Calcium salts | large amount |
| Copper salts | very small amount |
| Zinc salts | large amount |
| Iron salts | slight amount |
| Sodium salts | small amount |
| Ammonia | trace (0.4 mg./sq. ft.) |
| Silica | large amount |
| Organic matter | large amount |
| Water washings concentrated to 3 ml | pH 5.5 |
| WATER TEMPERATURE—200 F | |
| *Water-Insoluble Constituents* | |
| Ferric oxide | large amount, deposit not continuous |
| Silica | large amount |
| Carbonates | none |
| Cuprous oxide | very large amount |
| Cupric oxide | very lage amount, noticeably exceeds that on the tube tested at 170F |
| *Water-Soluble Constituents* (12 mg./sq. ft.—small compared to constituents above) | |
| Chlorides | moderately large amount |
| Sulfates | large amount |
| Calcium salts | large amount |
| Copper salts | very small amount |
| Zinc salts | large amount |
| Iron salts | slight amount |
| Sodium salts | small amount |
| Silica | large amount |
| Organic matter | large amount |
| Water washings concentrated to 2.6 ml | pH 5.5 |

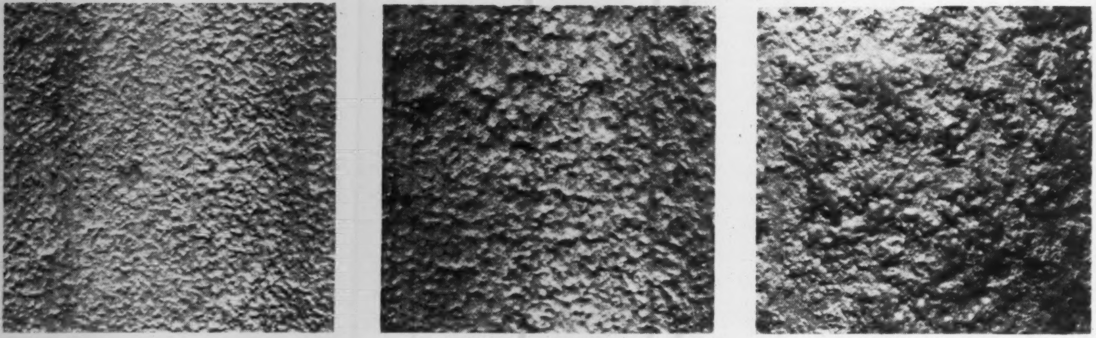


Fig. 6a Fig. 6b Fig. 6c

**6** RED BRASS TUBE SURFACES taken from MTP No. 2 (magnified 6x) looked like this after chemical cleaning. Figs. 6a and 6b handled sodium zeolite softened water at 2.3 fps and 170 F, Fig. 6c at 2.3 fps and 200 F

half length of admiralty and one-half length of 90/10 cupro-nickel connected by a closed couple. These two test panels utilized the same sodium zeolite softened water used for the studies on the copper tube, MTP No. 1.

## Red Brass Tubing Showed These Results

The red brass panel MTP No. 2 was operated the longest of any main test panels, namely, 21 months (632 days), compared to 17 months (498 days) for copper MTP No. 1.

At each of the four-month inspection periods the red brass tubes appeared to have been less affected by erosion-corrosion than were the copper tubes. Also, the corrosion of the red brass tubes appeared to be more uniform than that of the more highly pitted copper tubes. In fact, in only five out of the possible 30 temperature-velocity combinations per panel was the surface of the red brass tubing slightly rougher than for the copper; this occurred when the conditions were approximately 50 F and 1.5 and 2.3 fps. Because of the apparent lower erosion-corrosion, it was decided to operate the panel with the red brass until there might be a failure. However, since there did not appear to be any exceptionally weak spots when the inspection was made at the end of 21 months, it was decided to discontinue operation of the panel with the red brass.

After MTP No. 2 had been disassembled for the last time, a boroscope inspection was made and the half tubes were then sectioned and cut transversely into equal pieces for measurement, binocular microscopic observation, and various deposit studies.

The red brass tube was strongly attacked at high flow rates and temperatures by the sodium zeolite softened water. Figs. 1 through 6 illustrate the effects of temperature and velocity. These samples were photographed prior to chemical cleaning and at the end of the test period.

In Fig. 5 special note should be made of the increased corrosion at 140 F and 13.1 fps and at 170 and 200 F and 13.1 fps. Fig. 6 shows the attack on the surfaces of the red brass tube after corrosion products have been removed. In all cases the red brass tubes are not as pitted by corrosion as those of the copper tube under the same test conditions. Comparison should be made with similar photographs

TABLE 2—DEPTHS OF METAL LOST BY CORROSION from MTP No. 2 (red brass tube) are recorded below. Duration of test was 21 months. Quantities are given in thousandths of an inch

| Velocity, fps | Tubing diam. | Amount of loss in initial wall thickness | | 50 F | | | 80 F | | | 110 F | | | 140 F | | | 170 F | | | 200 F | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. |
| 1.5 | 1¼" | *Toler. | 59 | 6 | 11 | 8 | 3 | 10 | 6 | 6 | 10 | 8 | 8 | 10 | 9 | 4 | 9 | 6 | 7 | 11 | 9 |
| | | Nominal | 55 | 2 | 7 | 4 | 1 | 6 | 2 | 2 | 6 | 4 | 4 | 6 | 5 | 0 | 5 | 2 | 3 | 7 | 5 |
| | | Avg. meas. | 55 | 2 | 7 | 4 | 1 | 6 | 2 | 2 | 6 | 4 | 4 | 6 | 5 | 0 | 5 | 2 | 3 | 7 | 5 |
| 2.3 | 1" | *Toler. | 54 | 7 | 10 | 8 | 7 | 9 | 8 | 10 | 12 | 11 | 7 | 11 | 9 | 5 | 9 | 7 | 9 | 12 | 10 |
| | | Nominal | 50 | 3 | 6 | 4 | 3 | 5 | 4 | 6 | 8 | 7 | 3 | 7 | 5 | 1 | 5 | 3 | 5 | 8 | 6 |
| | | Avg. meas. | 47 | 0 | 3 | 1 | 0 | 2 | 1 | 3 | 5 | 4 | 0 | 4 | 2 | 2 | 2 | 0 | 2 | 5 | 3 |
| 3.9 | ¾" | *Toler. | 49 | 6 | 12 | 10 | 12 | 14 | 13 | 14 | 17 | 16 | 13 | 16 | 15 | 13 | 16 | 14 | 14 | 17 | 15 |
| | | Nominal | 45 | 2 | 8 | 6 | 8 | 10 | 9 | 10 | 13 | 12 | 9 | 12 | 11 | 9 | 12 | 10 | 10 | 13 | 11 |
| | | Avg. meas. | 43 | 0 | 6 | 4 | 6 | 8 | 7 | 8 | 11 | 10 | 7 | 10 | 9 | 7 | 10 | 8 | 8 | 11 | 9 |
| 8.1 | ½" | *Toler. | 44 | 10 | 12 | 11 | 7 | 9 | 8 | 10 | 12 | 11 | 12 | 16 | 14 | 8 | 13 | 10 | 11 | 15 | 13 |
| | | Nominal | 40 | 6 | 8 | 7 | 3 | 5 | 4 | 6 | 8 | 7 | 8 | 12 | 10 | 4 | 9 | 6 | 7 | 11 | 9 |
| | | Avg. meas. | 39 | 5 | 7 | 6 | 2 | 4 | 3 | 5 | 7 | 6 | 7 | 11 | 9 | 3 | 8 | 5 | 6 | 10 | 8 |
| 13.1 | ⅜" | *Toler. | 39 | 11 | 14 | 12 | 11 | 13 | 12 | 13 | 15 | 14 | 17 | 24 | 20 | 18 | 25 | 22 | 20 | 24 | 22 |
| | | Nominal | 35 | 8 | 10 | 8 | 7 | 9 | 8 | 9 | 11 | 10 | 13 | 20 | 16 | 14 | 21 | 18 | 16 | 20 | 18 |
| | | Avg. meas. | 33 | 5 | 8 | 6 | 5 | 7 | 6 | 7 | 9 | 8 | 11 | 18 | 14 | 12 | 19 | 16 | 14 | 18 | 16 |

Min. = Island loss. Max. = Pit loss. Avg. = Average loss.

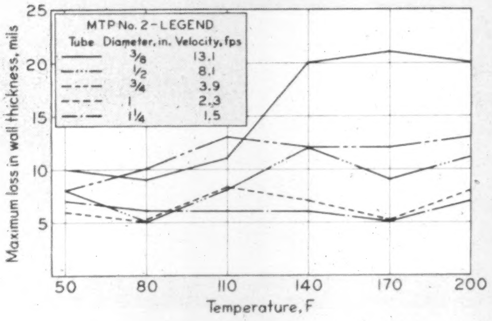


**Fig. 7**

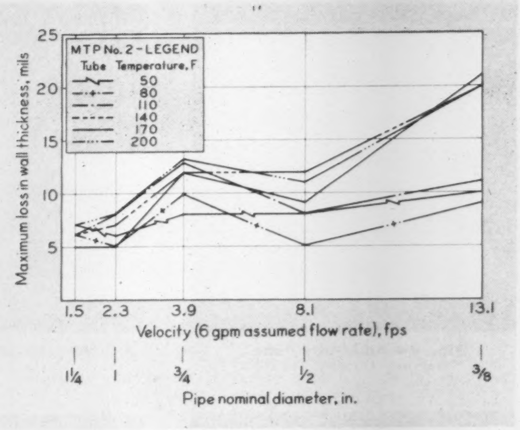


**Fig. 8**

**7-8** MAXIMUM LOSSES in wall thickness for MTP No. 2 (red brass) plotted here for temperatures, velocities

of the copper tubes reported in another article in this series, *Tests Show Effects of Water Quality at Various Temperatures, Velocities* (May).

For the 1¼ in. red brass tube, the constituents and their amounts in the deposits and corrosion products on the inner wall were determined semiquantitatively by microchemical analytical methods. Areas of about 0.4 sq ft were washed with large quantities of hot distilled water to pick up the soluble constituents; this water was evaporated to approximately 3.5 ml. The soluble constituents were determined on this amount of solution. Results are given in Table 1. It is noted that silica appears in both the insoluble and soluble groups. In the latter, it is probably present as a colloid. The amount of ammonia found is given, although ammonia probably had no significant effect on the corrosion of these tubes; it corresponds to the amount of ammonia usually found in the deposits on tubes exposed to fresh water. The analyses of the deposits removed from the red brass were similar to those found in copper tube treated under identical test conditions.

The depths of metal loss by corrosion of the red brass tubes of MTP No. 2 are listed in Table 2. This data includes random readings and readings for islands and pits as functions of nominal plus tolerance and average measured wall thicknesses, and illustrate the different values obtained depending on the basis of reference chosen for comparison.

TABLE 3—LOSS OF METAL from different sections of MTP No. 1 (copper) and MTP No. 2 (red brass), in percent, given below. Both test panels handled sodium-zeolite softened water, MTP No. 1 for 498 days and MTP No. 2 for 632 days

| Velocity, fps | Tube diam., in. | Test panel | 50 F | 80 F | 110 F | 140 F | 170 F | 200 F |
|---|---|---|---|---|---|---|---|---|
| 1.5 | 1¼ | No. 1 | 1.12 | 0.58* | 1.97 | 1.35 | 3.20 | 0.81 |
| | | No. 2 | 4.28 | 2.31 | 7.35 | 6.38 | 3.02 | 5.12 |
| 2.3 | 1 | No. 1 | 2.52 | 0.24 | 3.65 | 8.14 | 7.25 | 1.10 |
| | | No. 2 | 5.62 | 5.33 | 10.59 | 10.60 | 6.78 | 7.85 |
| 3.9 | ¾ | No. 1 | 3.86 | 0.26* | 9.49 | 11.26 | 12.62 | 8.13 |
| | | No. 2 | 9.19 | 9.59 | 15.52 | 13.12 | 11.06 | 11.91 |
| 8.1 | ½ | No. 1 | 5.80 | 0.55* | 10.08 | 11.51 | 29.19 | 9.28 |
| | | No. 2 | 14.38 | 11.51 | 13.31 | 29.11 | 15.40 | 22.22 |
| 13.1 | ⅜ | No. 1 | 6.24 | 0.25* | 13.38 | 27.78 | 41.45 | 32.53 |
| | | No. 2 | 20.20 | 17.71 | 21.43 | 43.90 | 40.59 | 44.76 |

*Tubing showed an apparent gain in weight.

Figs. 7 and 8 are the pointed micrometer readings of maximum loss in wall thickness *vs* temperature and velocity based on nominal wall thicknesses. These curves clearly illustrate the marked increased corrosion of red brass by sodium zeolite softened water with increases in temperature and velocity.

The loss in wall thickness was very pronounced and gravimetric tests were made on pieces of both

TABLE 4—FINAL OBSERVATIONS of surfaces after 632 days' test of red brass tube handling sodium-zeolite softened water are listed here

| Temperature, F | Velocity, fps | Tube diam., in. | Comments |
|---|---|---|---|
| 50 | 1.5 | 1¼ | Yellow-brown deposit; uniform. |
| | 2.3 | 1 | Same. |
| | 3.9 | ¾ | Patchy yellow-brown deposit with some bare areas. |
| | 8.1 | ½ | Slight inlet end erosion; same as ¾ in. |
| | 13.1 | ⅜ | Slight erosion through tube. |
| 80 | 1.5 | 1¼ | Yellow-brown film; thin; uniform. |
| | 2.3 | 1 | Same. |
| | 3.9 | ¾ | Same. |
| | 8.1 | ½ | Same. |
| | 13.1 | ⅜ | Very slight erosion at inlet end. |
| 110 | 1.5 | 1¼ | Very thin yellow-brown deposit; very thin yellow-green film at outlet. |
| | 2.3 | 1 | Same. |
| | 3.9 | ¾ | Same. |
| | 8.1 | ½ | Erosion at inlet. |
| | 13.1 | ⅜ | More erosion. |
| 140 | 1.5 | 1¼ | Thin, uniform streaky greenish-tan film. |
| | 2.3 | 1 | Same. |
| | 3.9 | ¾ | Same. |
| | 8.1 | ½ | Inlet end erosion and erosion grooving. |
| | 13.1 | ⅜ | Definite erosion; corrosion through tube. |
| 170 | 1.5 | 1¼ | Thin, streaky brown film; roughened surface. |
| | 2.5 | 1 | Same, but rougher. |
| | 3.9 | ¾ | Same. |
| | 8.1 | ½ | Slight deposit; rough eroded surface. |
| | 13.1 | ⅜ | No deposit; very rough eroded surface. |
| 200 | 1.5 | 1¼ | Thin brown film; rough surface. |
| | 2.3 | 1 | Same. |
| | 3.9 | ¾ | Same, but rougher. |
| | 8.1 | ½ | Overall erosion, corrosion. |
| | 13.1 | ⅜ | Badly eroded. |

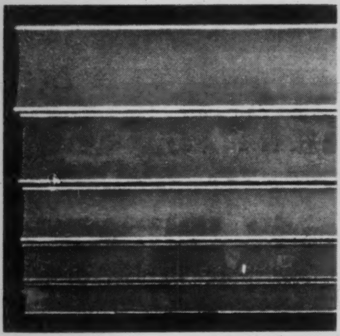


**Fig. 9—Admiralty tube**
Varying velocities, 110 F

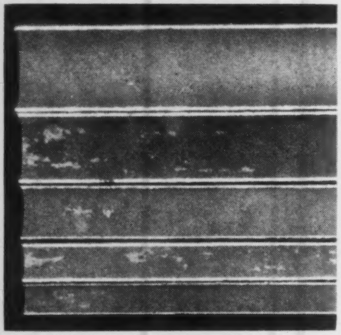


**Fig. 10—Admiralty tube**
Varying velocities, 140 F

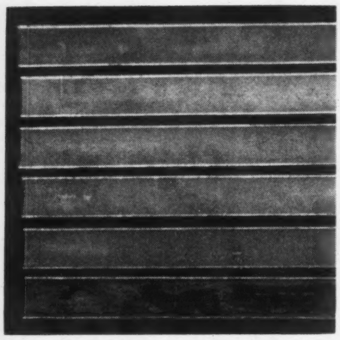


**Fig. 11—Admiralty tube**
¾ in., varying F, 3.9 fps

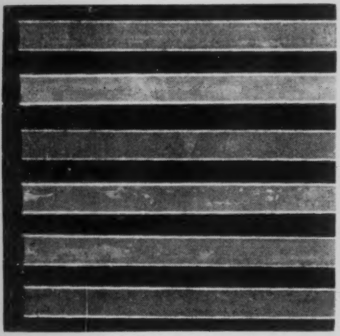


**Fig. 12—Admiralty tube**
½ in., varying F, 8.1 fps

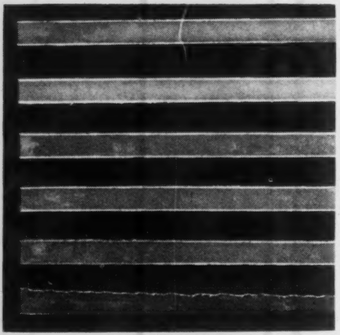


**Fig. 13—Admiralty tube**
⅜ in., varying F, 13.1 fps

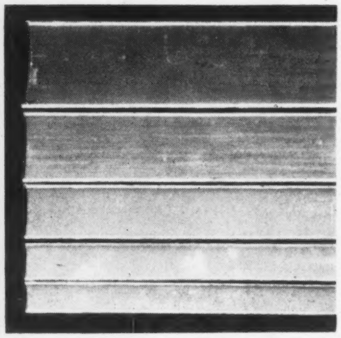


**Fig. 14—Cupro-nickel tube**
Varying velocities, 110 F

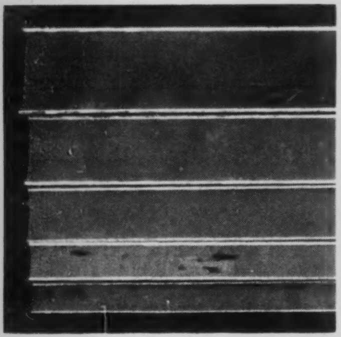


**Fig. 15—Cupro-nickel tube**
Varying velocities, 140 F

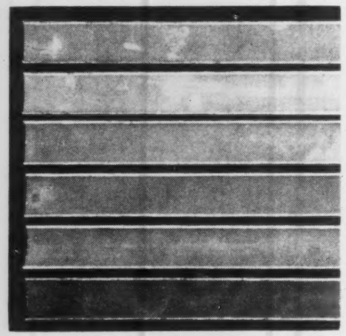


**Fig. 16—Cupro-nickel tube**
¾ in., varying F, 3.9 fps

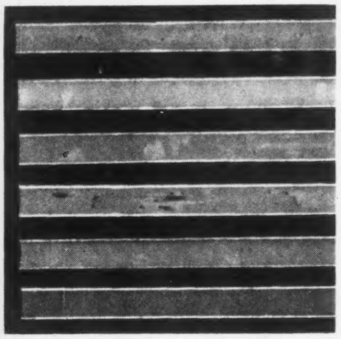


**Fig. 17—Cupro-nickel tube**
¾ in., varying F, 8.1 fps

**9-18** OVERALL RESISTANCE to erosion-corrosion attack of admiralty and cupro-nickel tubes is clearly evidenced by these photos. Compare these with Figs. 1 through 5 on page 126, and also with similar pictures in previous articles in this series in the May and July issues

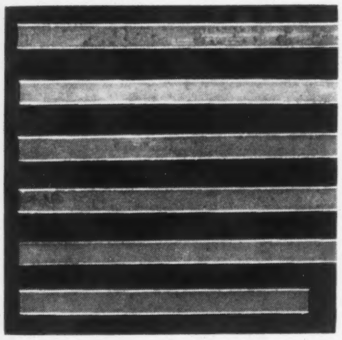


**Fig. 18—Cupro-nickel tube**
¾ in., varying F, 13.1 fps

**TABLE 5—FINAL OBSERVATIONS of surfaces of 90/10 cupro-nickel and arsenical admiralty tubes after 499 days' exposure to sodium-zeolite softened water are recorded below**

| Temperature, F | Velocity, fps | Tube diam., in. | Comments |
|---|---|---|---|
| 50 | 1.5 | 1¼ | All admiralty and cupro-nickel tubes had very thin, brown, powdery deposits which was a friable powder. Lower velocity admiralty tubes had a yellow appearing deposit. No corrosion attack. No inlet erosion attack on any inlet of tubes. |
| | 2.3 | 1 | |
| | 3.9 | ¾ | |
| | 8.1 | ½ | |
| | 13.1 | ⅜ | |
| 80 | 1.5 | 1¼ | All admiralty and cupro-nickel tubes had very thin, brown, powdery deposits and yellow deposits, same as 50 F tubes. However, deposits had flaked away in places on admiralty tubes. No corrosion attack. No inlet erosion attack on any inlets of tubes. |
| | 2.3 | 1 | |
| | 3.9 | ¾ | |
| | 8.1 | ½ | |
| | 13.1 | ⅜ | |
| 110 | 1.5 | 1¼ | All admiralty and cupro-nickel tubes had very thin, brown, and yellowish powdery deposit, same as 50 F and 80 F tubes. Some flaking of deposits on admiralty tubes. No corrosion attack. No inlet erosion attack on any inlets of tubes. |
| | 2.3 | 1 | |
| | 3.9 | ¾ | |
| | 8.1 | ½ | |
| | 13.1 | ⅜ | |
| 140 | 1.5 | 1¼ | All cupro-nickel tubes had brown deposits, while the admiralty tubes had yellow-brown deposits. No corrosion attack. No inlet erosion attack on any inlets of tubes. |
| | 2.3 | 1 | |
| | 3.9 | ¾ | |
| | 8.1 | ½ | |
| | 13.1 | ⅜ | |
| 170 | 1.5 | 1¼ | Cupro-nickel tubes had brown powdery deposits, darker than those at lower temperatures. No attack. Admiralty tubes yellowish brown, flaky deposits. Some surface roughening on ⅜ in. and ½ in. admiralty tubes. No inlet end erosion-corrosion attack on any inlet tubes. |
| | 2.3 | 1 | |
| | 3.9 | ¾ | |
| | 8.1 | ½ | |
| | 13.1 | ⅜ | |
| 200 | 1.5 | 1¼ | Cupro-nickel tubes had dark brown films, not a powdery deposit, no attack. Admiralty tubes' dark brown deposits flaked off in spots, exposing yellowish film underneath. Definite attack on ½ in. and ⅜ in. tubes, bright metal showing. |
| | 2.3 | 1 | |
| | 3.9 | ¾ | |
| | 8.1 | ½ | |
| | 13.1 | ⅜ | |

red brass and copper tubing. Two carefully measured 3 in. length samples of each piece of tube were cleaned with methyl ethyl ketone, 10 percent sulfuric acid at 140 F, and a 5 ~~percent acid~~ dichromate solution. Then they were weighed precisely. To determine the weight loss due to corrosion, new red brass tube was processed according to the same procedure. The data was converted into weights per unit length. The differences between the weights of the new tubing and the corroded tubing from the MTP No. 2 panel were taken as the losses in weigh due to corrosion. It was found that a maximum of 0.2 percent of the original weight of the new red brass tubing was lost during cleaning. This loss appears to be insignificant compared to the loss due to corrosion and is therefore disregarded.

From the data, a table showing the weight of metal loss per unit length as percentage of the original weight was made. These losses in weight as percentages for both copper and red brass are given in Table 3. Note, for red brass, that the most corrosive temperature is 140 F and that the most corrosive velocity is 13.1 fps. At 80 F the amount of corrosion is least for all velocity ranges. At water velocities ranging from 1.5 to 3.9 fps, the largest amount of corrosion occurred at 110 F. This is followed closely by 140 F.

Results obtained from the two analytical methods used to determine losses due to corrosion in the red brass panel agreed very closely. For example, with the 140 F and 13.1 fps sample, loss of weight was calculated from the remaining thickness, measured by pointed micrometer method, to be 43.91 percent. By the gravimetric method this was found to be 45.42 percent.

Corresponding data for other temperature-velocity combinations agrees well. In general, the red brass tubes lost weight to the extent of about 30 to 50 percent more than the copper tubes, except that, at 170 F, the loss of weight of the copper tube was greater than for the red brass tube. Pitting was more pronounced in the copper tube, yet the actual overall metal loss was more serious for the red brass. It appears that once deep pits are formed in either copper or red brass, erosion-corrosion seems to be somewhat more localized and more rapid deterioration occurs in the pitted areas.

Bearing in mind that the red brass panel was operated 30 percent longer than the copper panel (632 days *vs* 498 days), comparison of Figs. 7 and 8 for red brass with Figs. 1 and 4 for copper (May, p. 109) indicates that red brass is attacked less by the aggressive sodium zeolite softened water in the velocity range of about 8 fps and temperature of about 170 F. The graphs also show that, for all velocities, copper has as good or better overall resistance to corrosion by an aggressive sodium zeolite

**TABLE 6—MEASUREMENTS OF ADMIRALTY TUBE in MTP No. 7 yielded these readings in terms of wall thicknesses and depths. Panel handled sodium-zeolite softened water for 17 months. All readings are given in thousandths of an inch**

| Velocity, fps | Tube diam. | Nominal wall thickness | Minimum remaining wall thickness | | | | | | Maximum depth | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 50 F | 80 F | 110 F | 140 F | 170 F | 200 F | 50 F | 80 F | 110 F | 140 F | 170 F | 200 F |
| 1.5 | 1¼" | 55 | 51 | 51 | 50 | 51 | 49 | 50 | 4 | 4 | 5 | 4 | 6 | 5 |
| 2.3 | 1" | 50 | 48 | 46 | 45 | 43 | 43 | 45 | 2 | 4 | 5 | 7 | 7 | 5 |
| 3.9 | ¾" | 45 | 41 | 42 | 38 | 38 | 39 | 37 | 4 | 3 | 7 | 7 | 6 | 8 |
| 8.1 | ½" | 40 | 36 | 36 | 33 | 33 | 34 | 26 | 4 | 4 | 7 | 7 | 6 | 14 |
| 13.1 | ⅜" | 35 | 32 | 31 | 29 | 28 | 28 | 3 | 3 | 4 | 6 | 7 | 7 | 32 |

| Velocity, fps | Tube diam. | Nominal wall thickness | Wall thickness at 10 deepest points, avg. | | | | | | Loss in wall thickness at 10 deepest points, avg. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 50 F | 80 F | 110 F | 140 F | 170 F | 200 F | 50 F | 80 F | 110 F | 140 F | 170 F | 200 F |
| 1.5 | 1¼" | 55 | 53 | 51 | 51 | 52 | 50 | 51 | 2 | 4 | 4 | 3 | 5 | 4 |
| 2.3 | 1" | 50 | 53 | 52 | 51 | 50 | 50 | 51 | 2 | 3 | 4 | 5 | 5 | 4 |
| 3.9 | ¾" | 45 | 43 | 44 | 39 | 38 | 40 | 38 | 2 | 1 | 6 | 7 | 5 | 7 |
| 8.1 | ½" | 40 | 37 | 37 | 34 | 34 | 35 | 28 | 3 | 3 | 6 | 6 | 5 | 12 |
| 13.1 | ⅜" | 35 | 33 | 32 | 29 | 28 | 29 | 4 | 2 | 3 | 6 | 7 | 6 | 31 |

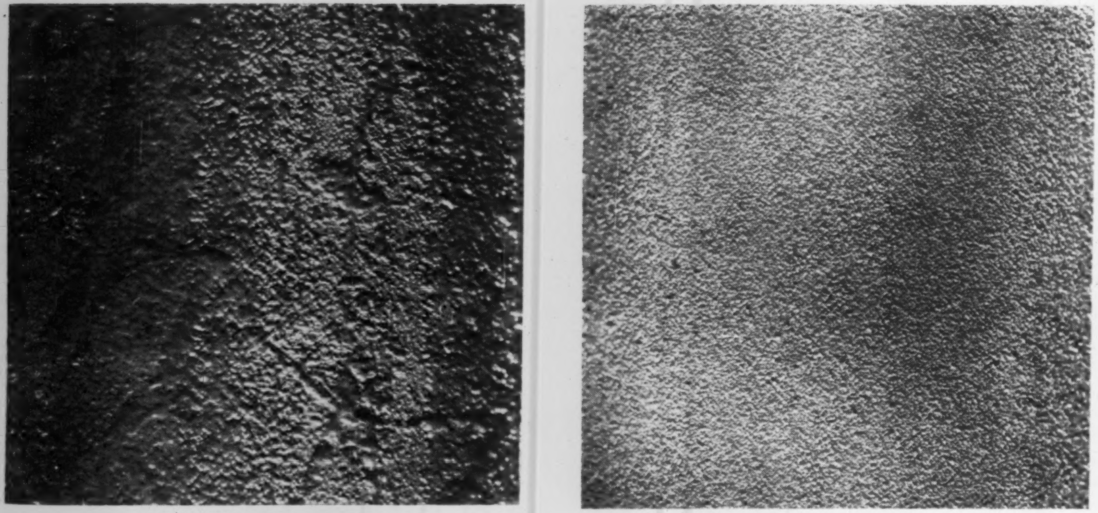


**Fig. 19a**—2.3 fps, 170 F

**Fig. 19b**—2.3 fps, 200 F

**19** ADMIRAL TUBE SURFACES of MTP No. 7 (magnified 6x) appeared as above after chemical cleaning. Note absence of pitting

softened water than does red brass. Table 4 records the comments about the deposits observed on the red brass tube when they were removed for the last time after 632 days.

Comparative results for the copper and red brass tubes can be summarized:

1) Copper and red brass were found to be relatively adversely affected by the aggressive sodium zeolite softened water used in these tests at high water velocities and temperatures.

2) With sodium zeolite softened water containing oxygen and carbon dioxide, red brass corrodes more rapidly than copper. The attack is more uniform and overall on the red brass tube than on the copper tube.

3) Erosion-corrosion is more noticeable on copper than on red brass, especially at high water velocities.

4) Total corrosion appears to be the net result of temperature, velocity, and water quality. It does not appear to be due to any one of these factors alone.

## Using Admiralty and 90/10 Cupro-Nickel

MTP No. 7, consisting of half sections of 90/10 cupro-nickel and of admiralty tubes, was operated 17 months (498 days) with sodium zeolite softened water. The panel was inspected every three months and on final removal was subject to the same boroscope, binocular microscope observation, and micrometer measurements as employed on the other test panels.

The overall appearance of the 30 cupro-nickel and 28 of the 30 admiralty samples, after final removal and sectioning, was excellent and showed little attack. Final observations made of the uncleaned tubes are given in Table 5. In general, each of the samples had only a light powdery film. The powdery deposits on all cupro-nickel tubes were always the same general brown color, varying only in shades. The admiralty tubes were coated predominantly with a brown deposit, but for some of the lower velocities and higher temperatures, the colors were pronounced

TABLE 7—MEASUREMENTS OF 90/10 CUPRO-NICKEL TUBE in MTP No. 7 in terms of wall thicknesses and depths are given below. For 17 months, panel handled sodium-zeolite softened water. All readings given in thousandths of an inch

| Velocity, fps | Tube diam. | Nominal wall thickness | Minimum remaining wall thickness 50 F | 80 F | 110 F | 140 F | 170 F | 200 F | Maximum depth 50 F | 80 F | 110 F | 140 F | 170 F | 200 F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.5 | 1¼" | 55 | 52 | 53 | 53 | 53 | 52 | 53 | 3 | 2 | 2 | 2 | 3 | 2 |
| 2.3 | 1" | 50 | 48 | 48 | 48 | 48 | 48 | 48 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3.9 | ¾" | 45 | 44 | 44 | 44 | 42 | 41 | 42 | 1 | 1 | 1 | 3 | 3 | 3 |
| 8.1 | ½" | 40 | 40 | 40 | 38 | 39 | 38 | 39 | 0 | 0 | 2 | 1 | 2 | 1 |
| 13.1 | ⅜" | 35 | 33 | 34 | 33 | 32 | 33 | 33 | 2 | 1 | 2 | 3 | 2 | 2 |

| Velocity, fps | Tube diam. | Nominal wall thickness | Wall thickness at 10 deepest points, avg. 50 F | 80 F | 110 F | 140 F | 170 F | 200 F | Loss in wall thickness at 10 deepest points, avg. 50 F | 80 F | 110 F | 140 F | 170 F | 200 F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.5 | 1¼" | 55 | 53 | 54 | 54 | 54 | 53 | 54 | 2 | 1 | 1 | 1 | 2 | 1 |
| 2.3 | 1" | 50 | 49 | 49 | 49 | 49 | 49 | 49 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3.9 | ¾" | 45 | 44 | 44 | 44 | 43 | 43 | 43 | 1 | 1 | 1 | 2 | 2 | 2 |
| 8.1 | ½" | 40 | 40 | 40 | 39 | 40 | 39 | 40 | 0 | 0 | 1 | 0 | 1 | 0 |
| 13.1 | ⅜" | 35 | 34 | 34 | 34 | 33 | 33 | 34 | 1 | 1 | 1 | 2 | 2 | 1 |

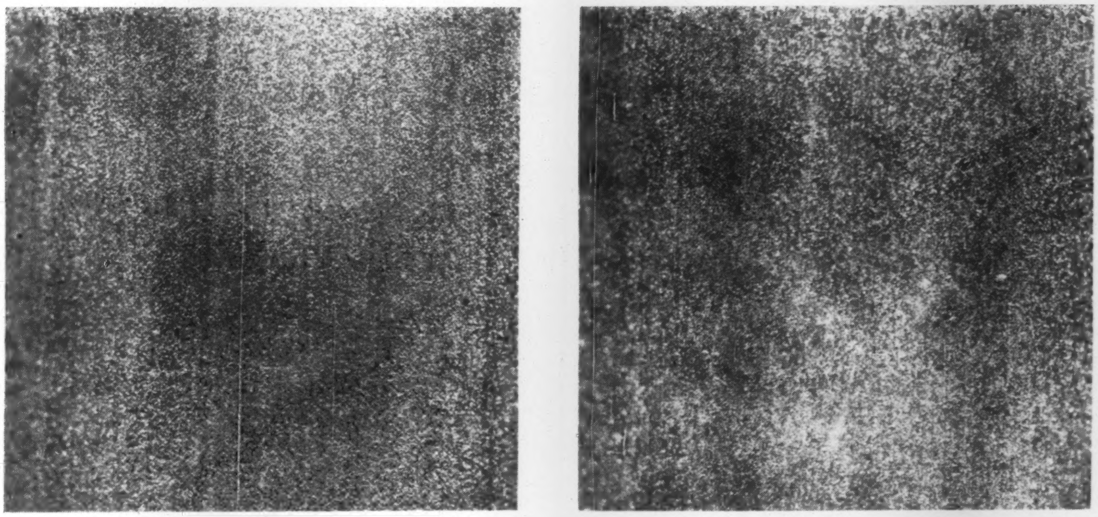


**Fig. 20a**—2.3 fps, 170 F

**Fig. 20b**—2.3 fps, 200 F

**20** CUPRO-NICKEL TUBE SURFACES of MTP No. 7 (magnified 6x) after cleaning shown here. In no case was serious corrosive attack observed

yellow or golden brown. The 30 samples of the 90/10 cupro-nickel tube showed no attack or pitting.

All surfaces were clean and smooth after chemically removing the light powdery brown deposits. Two of the 30 admiralty tubes showed the effects of temperature and velocity to a serious extent. These two tubes (½ and ⅜ in.) were in the 200 F loop and the velocities were 8.1 and 13.1 fps. Also, the ¾ in. admiralty tube in the 200 F loop showed small anodic and large cathodic areas.

Overall resistance to erosion-corrosion attack of these two copper alloys is clearly shown in Figs. 9 through 18. A marked thinning of the wall of the admiralty tube at 200 F and a velocity of 13.1 fps is indicated in Fig. 13. In no case — even at 200 F and 13.1 fps — was the 90/10 cupro-nickel noticeably attacked. These pictures should be compared with similar ones in previous articles in this series for copper (May) and red brass (July). All three materials used the same sodium zeolite softened water as a source of corrosive environment.

Conditions of the surfaces of several of the tubes after chemical cleaning are illustrated in Figs. 19 and 20. Note the absence of pitting. In no case was serious corrosive attack under the deposits observed — as had been noted in the tests with the copper tube and blended water at high temperatures.

Since no noticeable corrosion attack or pitting was observed in any of the 90/10 cupro-nickel tubes and in only two of the 30 admiralty tubes, results of micrometer measurements are reported in a more detailed way in the form of tables; graphs were not prepared. Data was reported on (1) minimum remaining wall thickness, (2) maximum depth found at any point in the slightly roughened surfaces, (3) the average wall thicknesses of 10 of the deepest points, and (4) losses of wall thickness of 10 of the deepest points. The term *deepest point* is used, since no well-defined pits were encountered such as were noted in the test specimens for copper and red brass. A pitting type of attack was seen only in the two admiralty tubes mentioned. In general, there were only slight variations in the other 58 samples; these could be attributed to slightly different potentials between different deposit areas.

Readings taken for the 30 admiralty tubes are recorded in Table 6. Those for the thirty 90/10 cupro-nickel tubes are given in Table 7. Note that the wall tolerance for 1¼ in. tube is ± 0.0045 in., for the 1 in. and ¾ in. tubes it is ± 0.004 in., and for the ½ in. and ⅜ in. tube it is ± 0.0035 in.

The data given in Table 6 clearly illustrates the resistance of admiralty tube to corrosive attack. Only two of the 30 tubes show any appreciable evidence. These tubes were run at 200 F and 8.1 and 13.1 fps. For all velocities up to 13.1 fps and temperatures of 140 and 170 F and all velocities below 8 fps and at 200 F, the corrosion resistance of the admiralty tube was excellent. At all other temperature and velocity conditions, the corrosion recorded was negligible.

For 90/10 cupro-nickel, it is shown in Table 7 that maximum depths of the deepest points of the anodic areas were within the plus or minus tolerances of the tubes in all cases. This copper alloy showed excellent resistance to erosion-corrosion by the gasified sodium zeolite softened water for all combinations of temperatures and velocities. +

# Aero-Space Industry Opens New Horizons For Air Conditioning Design

**• Air conditioning systems for aircraft, missiles, and rockets are far different from conventional systems. Last month, the author described some of these differences and briefly discussed the problems in computing heating and cooling loads. Here, he turns to system design and selection of equipment.**

By ROBERT BERNER
Staff Design Engineer
Technical Development Dept.
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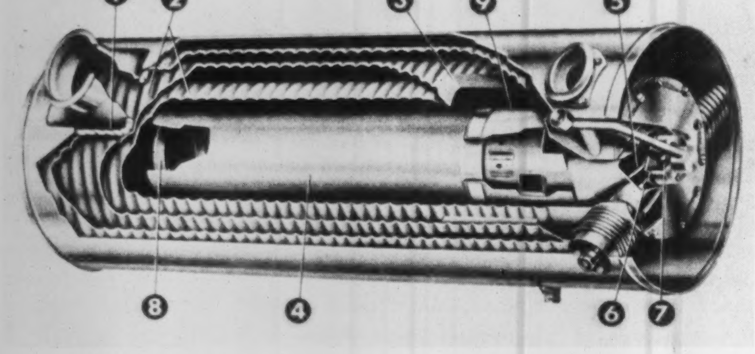
HAVING determined the size of the cooling job for aircraft air conditioning, we can then proceed to the design of a system and selection of suitable equipment. With early open cockpit type aircraft, the problem of ventilation did not exist. As the design was changed to close in the cockpit, the first systems naturally embodied provision for ventilation.

As altitudes increased and lower temperatures were encountered, heating was required. Initial designs employed the use of exhaust gas heat exchangers, but these were subsequently replaced by fuel burning combustion type heaters. Fig. 1 is typical of this type of equipment. This heater is rated at 200,000 Btu per hr and is approximately 10 in. in diameter and 23 in. long.

With the addition of pressurization on aircraft, we acquired an additional source of heat in the compression heat of the air as it was compressed from ambient to cabin conditions. However, this additional heat produced a rather significant problem at low altitude and gradually led to the need for cooling systems. About this same time, jet powered aircraft entered the picture. With the jet engine we had a source of high pressure air which could be used to power a cooling system. As a result, initial system designs moved in the direction of air cycle systems in which the air itself became the working refrigerant.

Several types of air cycle cooling systems have come into general use. Fig. 2 shows what is termed a simple air cycle system. In all such systems, air is bled from a compression source, in this case shown as a jet engine. The air is then passed through an intercooler to remove the majority of the heat of compression and is then expanded through an air turbine. The turbine is made to do mechanical work and the resultant heat energy is extracted from the air. The air then leaves the turbine at a reduced temperature level and is available for cooling. Air supplied to the intercooler to remove the heat of compression is drawn from the outside, and the flow is aided by the use of the fan which has, as its energy input source, the power of the cooling turbine.

The cooling capacity of a system of this type depends basically on the available ratio of inlet to outlet pressure at the cooling turbine. With increase in jet engine performance, the system performance of the simple air cycle proved adequate for many military applications. However, for commercial applica-



**1** CUTAWAY VIEW shows components of typical aircraft heater

1) **Exhaust gasket**
2) **Combustion tube and radiator assembly**
3) **Crossover passage**
4) **Combustion tube and cone assembly**
5) **Ground electrode**
6) **Spark plug**
7) **Spray nozzle**
8) **Reinforcing ring**
9) **Bulkhead**

tions in which the available power source was a compressor driven by the reciprocating engine the available turbine pressure ratio was quite limited. This proved to be a major limitation on system capacity.

### Develop "Boot-Strap" System

As a result, the so-called "boot-strap" system was developed. Fig. 3 shows this arrangement. Air is drawn from the compressor source and passed over an intercooler to remove the heat of compression. It then passes through a second stage of compression and through a second intercooler which removes the additional heat of compression. It is then expanded in the cooling turbine.

Because of the additional pressure provided by the second compressor and since the pressure ratio across the cooling turbine is higher, the available cooling is also greater than with a simple system. The output of the cooling turbine is used in this system to provide the power input for the second stage of compression. It is necessary to provide cooling air across the intercoolers through the use of ram air in flight. In order to provide operation for a system of this type on the ground it is necessary to add fans or similar means for providing this intercooler air flow during nonflight operation.

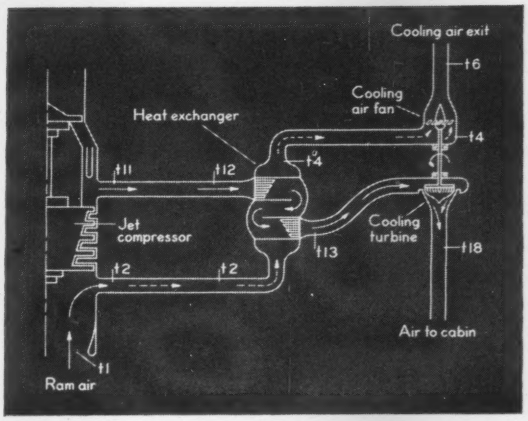
Air cycle systems are, of course, limited by the ram temperature rise. At high speeds, the temperature level is such that it is impossible to produce a sufficient temperature drop through the system to provide air at the turbine outlet at a usable level for cooling. An additional system has been developed employing the use of an evaporative type water boiler in series with the intercoolers. Fig. 4 shows this arrangement as applied to a simple system. In this system an additional heat sink is provided by boiling off the water and absorbing the latent heat of vaporization. This can be accomplished at quite low temperature levels at altitude.

Equipment for use in air cycle systems embodies the use of high speed rotating machinery. Fig. 5 shows the type of system which was used on the Martin XP6M-1 aircraft. It is a modification of the simple air cycle. The first pass of the intercooler is made of steel because of the temperature levels involved. An indication of the size of this unit may be judged from the fact that the intercooler is approximately a 16 in. cube. The unit weighs less than 100 lb and has a cooling capacity of approximately $4\frac{1}{4}$ tons. Its turbine speed at normal rated design point is approximately 78,000 rpm.

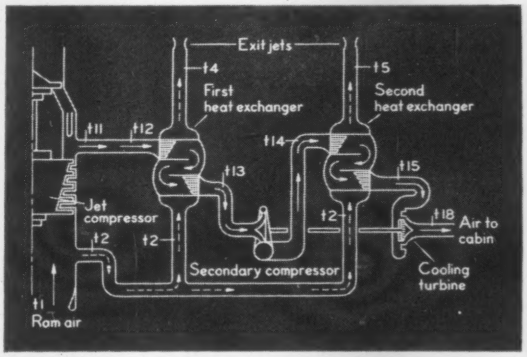
### Air Cyle Suited for Air Installations

If this type of unit is being considered for ground application, it is necessary to consider the fact that air cycle systems of this type are not necessarily economical on power. This particular unit requires about 19 hp per ton at its rated design condition. This horsepower is supplied by the high pressure air.

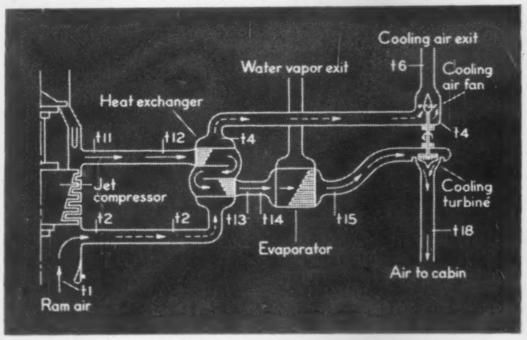
Since air cycle systems require operation of the engine or a ground source of high pressure air at high air flow rates, there has been a trend in the case


Cooling air exit
t6
Cooling air fan
t4
Heat exchanger
t11
t12
t4
Jet compressor
Cooling turbine
t13
t18
t2
t2
Air to cabin
t1
Ram air

**2** AIR CYCLE cooling system bleeds air from jet engine. Cooling capacity depends on available ratio of inlet to outlet pressure at cooling turbine


Exit jets
t4
t5
First heat exchanger
Second heat exchanger
t11
t12
t14
t13
t15
Jet compressor
t2
t2
t2
t18
Air to cabin
Secondary compressor
Cooling turbine
t1
Ram air

**3** "BOOT-STRAP" system was developed to correct shortcomings of simple air cycle system; available cooling capacity is greater


Cooling air exit
Water vapor exit
t6
Cooling air fan
Heat exchanger
t11
t12
t4
t4
Jet compressor
Cooling turbine
t2
t2
t13
t14
t15
t18
Evaporator
Air to cabin
t1
Ram air

**4** AT HIGH SPEEDS, air cycle systems are subject to ram temperature rise. Here, evaporator has been added to simple system to combat this of commercial aircraft to use some other means of cooling. Operation on the air cycle systems under ground conditions can require fairly high engine speed for reciprocating engine applications. The alternate use of a separate ground air conditioning unit, while feasible at major terminals, becomes economically impractical where many intermediate stops are involved.

## Vapor Cycle Enters the Picture

For these reasons, vapor cycle systems entered the picture. The early DC7 installation employed the use of a vapor cycle system in addition to the basic air cycle system embodied on the airplane. The vapor system capacity was approximately 5 tons and was in addition to an air cycle system also having about a 5 ton capacity. The Lockheed Electra also employed a similar type of thinking, using a system which has a vapor cycle system capacity of 12 tons. The larger jet aircraft, such as the 707 and DC8, employ dual vapor cycle systems each having a rating in the 12 to 13 ton range, thus giving a total installed capacity of about 25 to 26 tons.

These vapor cycle systems are conventional in design but generally require a somewhat higher compressor horsepower per ton since condensing temperatures are usually higher than those for ground applications. The compressors used on the systems are driven either by 400 cycle electrical power or, in the case of the DC8, by an air turbine supplied by bleed air from the jet engine or a ground source. Air supply for cabin pressurization in these instances is usually provided by a separate turbine driven cabin air compressor.

Associated with all these different types of systems are a number of common problems which differ in many respects from similar problem areas in ground application.

Water separation, particularly in the case of air cycle systems, is significantly different. Since the air cycle turbines are high speed rotating machines, condensation occurring in the system will be discharged from these units in the form of a very finely divided fog. It is usually necessary to precipitate this fog in order to get it into droplet form before we can adequately provide removal.

## Develop Lightweight High Pressure Ducts

Associated also with air cycle systems is the problem of distribution of high temperature high pressure bleed air from the jet engines. In recent high performance aircraft, bleed pressures may run in excess of 200 psi at temperatures above 800 F. Distribution of this air is a problem not unlike that of the distribution of high pressure high temperature steam in normal power plant or heating practice. It is necessary to provide adequate expansion for ducting in this temperature range. Velocities in these ducts are also in the order of 200 to 300 fps. Since we cannot absorb the weight of conventional high pressure piping using heavy flanges, it has been necessary to develop lightweight stainless steel ducting using thin wall high strength tubing, and to develop associated means of assembly of such ducts.

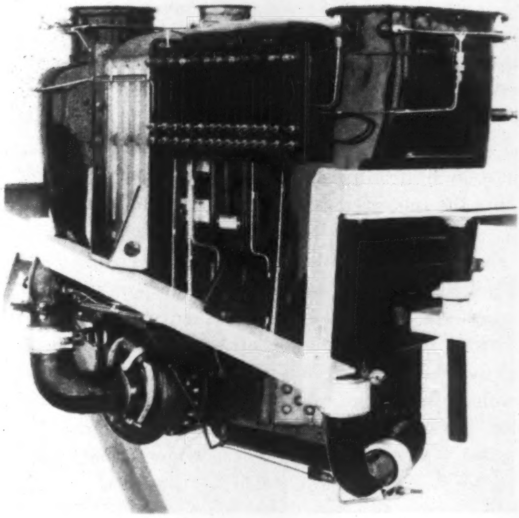
The problem of air distribution is one of attempting to supply a large amount of air in a small amount of space and at the same time minimizing drafts. This is usually a major development item in any design. Cabin pressure is usually controlled by allowing all air to exit from the cabin at a given point and then providing an automatically controllable throttling valve at this location. In air cycle systems for military applications, temperature control systems encounter changes as high as 60 to 70 F per sec in the supply air. Temperature control systems are usually electronic or pneumatic. Pneumatic controls are used extensively with air cycle systems, since a source of pneumatic pressure is readily available.

As we proceed to higher altitudes and higher speeds, we find definite limitations occurring on the aforementioned types of systems. In addition to the limitation of ram air temperature, the air cycle systems are limited by lack of air at altitudes. With the low ambient pressures, the available bleed pressure from jet engines decreases. Since the cabin pressure must be held at a fixed level because of physiological reasons, the available pressure ratio for cooling turbines becomes very limited. The use of vapor cycle systems in high speed is limited due to the critical temperature of refrigerants when operating at high condensing temperature levels.

Under such conditions it then becomes more practical to avoid the use of outside air wherever feasible, and to bring in only the amount needed to provide pressure control. The tendency is then toward the use of an internal heat sink embodied on the vehicle itself. Air or liquid recirculating type systems are used to transfer the heat from the heat source to the heat sink. In the event that the temperature level which must be maintained for personnel or equipment use is below that at which the heat sink can operate, a vapor cycle system may be employed as a step-up device to dispose of the heat to the heat sink at the condensing temperature level.

## Next Is Pressure Suit

With the use of extreme altitudes, pressure suits become mandatory since failure of the cabin could result in instant death. One difficulty with the use of pressure suits lies in the fact that they must be designed, of course, to be impervious to air loss. They are thus automatically impervious to body moisture. In order to prevent accumulation of body moisture



**5** THIS SYSTEM, used in Martin XP6M-1 aircraft, is another modification of simple air cycle system. Weighing less than 100 lb, cooling capacity is 4½ tons

and body heat it is necessary to employ a ventilating garment underneath the pressure suit.

It becomes a short step, then, from design of advanced type systems of these kinds to the design of a sealed cabin which is basically required for the use of very high performance aircraft or for space applications. Before discussing the design of space cabin systems, let us first briefly consider the problem of missiles and rockets, since large rockets are used to provide the necessary boost thrust for space applications. The type of conditioning problem which results from any missile application depends largely upon the flight trajectory of that missile.

## Missiles in Two Basic Types

In general, missiles or rockets fall into two basic categories; first, the surface-to-surface missiles which are launched from the earth surface to an earth target and, secondly, the air-to-air missiles which are launched from an air vehicle to an air target. Variations from these basic types exist in the case of surface to air or air to surface type missiles.

The surface-to-surface types range from the high subsonic air-breathing types, such as the Mace and Snark, to the ICBM ballistic types. The aircraft types of missiles have performance which is similar to that of aircraft and the cooling systems tend to follow aircraft design.

The ballistic types have a flight trajectory in which a large portion is outside of the earth atmosphere. They are subject to high heating rates following launch for short periods of time. The portion of the missile which returns is subject to extremely high rates during the re-entry period. Air-to-air missiles are usually characterized by high speed missions of short duration. The surface-to-air or air-to-surface missions tend to follow patterns which are similar to the similar portions of the basic missile types.

Since missile types and designs are quite varied, the type of conditioning systems employed also varies. It is convenient to discuss the systems in terms of the problems encountered during each portion of the trajectory.

Conditioning problems occur during the following phases of operation:

1) *Ground storage.* Missiles are usually subject to ground environmental problems for extended periods of time. The general attempt is made to design the missile so that it can live in this environment with a minimum amount of conditioning. Equipment on the missile in this phase is usually not operated.

2) *Ground checkout.* During this phase the missile is made ready for use and frequently the electronics equipment is subject to functional or adjustment types of checks. The problem is primarily one of removal of the internal heat which is generated. This is usually accomplished by circulation of air or liquids through the compartment or the equipment.

3) *Launch.* Following launch, the missile is usually subjected to high heating rates for fairly short periods of time. In the case of ballistic type applications in which the various stages of propulsion are separated at time intervals, the equipment must be cooled for a relatively short period of time. Attempts are made to employ thermal lag wherever feasible, or to prevent heating through the use of insulation and shielding. If this is insufficient, then additional conditioning may be employed through the use of techniques embodying the evaporating of such fluids as water.

4) *Re-entry.* For those portions of the missile which must re-enter the atmosphere, protection against the high heating rates is usually accomplished by the use of heat sink material or ablating material. Ablation may be considered as a condition in which the outside structure of the re-entry body vaporizes, absorbing the latent heat of vaporization of the material. Internal equipment which must function during the re-entry period is protected by radiation shielding and insulation, and evaporative cooling may be employed if the shielding is inadequate.

5) *Captive flight.* For air-to-air type missiles in which captive flight involves high speed portions of the mission which exist only for short time durations, the approach is to attempt to design the missile to live in the environment and provide sufficient internal heat sink or thermal lag to protect the equipment. With increase in flight time at high speeds, this problem will become more severe. In the event that ther-

mal lag or similar protection is inadequate, it will be necessary to provide additional insulation and possibly some means of evaporative cooling for the equipment.

6) *Active flight.* Since the active flight time for air-to-air type missiles is usually short, again the design is usually based on time lag, with insulation or evaporative techniques available if required.

7) *Orbital flight.* The problem of cooling during orbital flight is intimately involved with the design of sealed and space cabins and will be discussed in that connection.

## Sealed Cabins Pose Still Other Problems

With the advent of completely sealed cabins, we encounter several additional problem areas not previously mentioned. The first of these is control of the composition of the atmosphere inside of the cabin. It is likely that the initial cabin pressure levels which will be used will approach the 25,000 ft cabin altitude limit previously mentioned in order to keep overall weight low. To avoid the necessity for the use of an oxygen mask or similar type of equipment, it will be necessary to provide an atmosphere in which the oxygen content has been increased. Oxygen levels will then be above 50 percent. Coupled with this, of course, will come the potential fire hazard problem.

Work is being done in this area at present in problems which may arise and can be engineered or designed out of the system with little difficulty. Since individuals also produce carbon dioxide in the normal breathing process, it will be necessary to remove this in order to prevent accumulation, with adverse physiological effects. For the flight time duration involved, the most likely way of handling this problem will be to absorb the carbon dioxide in a bed of lithium hydroxide, using a recirculation air type of system. As ability to place increased weight into orbit improves, pressure levels in the cabin will undoubtedly approach sea level values.

Another major problem area is in the control of humidity. Closely related to this is the control of internal temperature to limits which will prevent increase in body moisture production activity, in order to provide a limitation on the amount of moisture which must be removed.

Removal of moisture can be accomplished through the technique of condensing the moisture on the cold surface, similar to that used in present ground applications, and then providing a mechanical means of removal. An alternate way of removing moisture would be through the absorption of the moisture in an absorbent bed such as anhydrone. The use of absorption beds for carbon dioxide and moisture removal adds to the size of the cooling job because of the chemical heat of reaction which occurs in the absorption process.

## Control Temperature by Coatings, Evaporation

For unmanned flight vehicles, temperature control has been accomplished largely through the use of passive coatings on the surfaces. It is possible to provide a surface condition which will reject heat from the vehicle at the surface temperature level and at the same time will reflect solar heat, thus minimizing the solar heat absorbed. Such a technique is feasible where the internal heat generated is small and where the surface of the vehicle is relatively large.

For systems involving human occupancy and larger heat loads, it is likely that evaporation techniques will be used. Heat exchange surface will be provided in a recirculation air system. Water can be fed to the exchanger, and flashed at the low pressures involved into steam, picking up the heat of vaporization. An alternate means would be to provide a flooded boiler type of design in which the evaporation temperature is controlled by throttling the discharge line. As cooling loads and flight durations increase, it will be necessary finally to resort entirely to the use of radiators, since radiation is the sole means of heat exchange under orbital conditions.

One of the major problems which will be encountered in application of systems for sealed space cabins will be the problem of weightlessness. The vehicle is in orbit primarily because of a balance between the force of gravity and the tendency for centrifugal force to cause the vehicle to go on out into space. This results in the weightless condition for items within the vehicle. Under a situation of this type it will be necessary to provide a positive means of circulation for removal of air. For example, the carbon dioxide which is exhaled would remain near the face unless dispelled by positive air circulation.

Again, with application of boiling, the basic reasons that a heated bubble rises from a heated surface is due to difference in density of the fluids and the bubble. Since the absence of gravity eliminates this factor, there is no reason for a bubble to move away from the heated surface. It will remain on the surface and will tend to grow in size until it blankets the surface and burnout occurs. The problem of weightlessness is further complicated by the inability to provide a means of testing at sea level, or in flight, for extended periods of time.

As flight times increase from hours or days into weeks or months, the arrangement of these systems will change rapidly. Ultimately, it will be necessary to employ a closed ecological system in which all items necessary to sustain life are manufactured on the vehicle—a subject which is beyond the scope of this article, but was discussed in the October 1959 HPAC Engineering Data File, *Environmental Control Is Key to Success of the Manned Earth Satellite.* ∓

Figure credits: Fig. 1, Janitrol Div., Surface Combustion Corp.; Figs. 2-5, AiResearch Mfg. Co.

**SAMUEL R. LEWIS, consulting mechanical engineer and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors, comments informally on practical problems in the field.**

## Sam Lewis says:

# "Each Piece of Equipment Must Be Reachable By Reasonable Stairway or Ladder"

WITH ALL that he knows, all of the things that he is able to do today that had him in a quandary as late as only yesterday, man has established himself as being a somewhat imaginative creature.

But in spite of all this creative genius, he sometimes displays very poor judgment. Let me reflect on a couple of my observations to bear this out:

One of his worst offenses in mechanical design is his disregard for access for maintenance. I recall a three-story building, 200 ft long, and facing east and west. Two central ventilating plants, complete with air filters, heating coils, cooling coils, and exhaust recirculation fans were installed in the attic.

This triangular cross-section, which is above the top story and under the sharply sloping roof, is obstructed by large insulated supply and exhaust ducts and by insulated heating and cooling water pipes, drainage pipes, and electrical conduits.

Admittance to the attic is by a vertical metal ladder from the third story at the west end only. Access is through one boy-sized hatchway.

In order to lubricate bearings, change filters, and perform other routine maintenance chores, servicemen had to crawl 200 ft over and under the insulated attic ducts. This, of course, did the insulation on them no good, and damaged their clothing. A code-required disconnect switch was on each fan motor. In one case I found the switch hidden behind an obstructing partition and in the dark, remote from its motor.

Let it be law that each piece of equipment be reachable by a reasonable stairway or ladder. Let the mechanical engineer who ignores this canon walk the streets hunting a new job.

The hot boiler room is another manifestation of man's seeming lack of wisdom. In these days of gaseous and liquid fuels, the chimney for removal of combustion waste from heating system boilers has been reduced in size until it refuses to play any part in cooling the boiler room.

Natural draft is superseded by automatically controlled forced draft. Boiler rooms must therefore have definite ventilating plants, lest operating personnel be carried out on a litter. The boiler room, like the kitchen in a restaurant, must include provision for a positive circulation of relatively cool air.

It is a credit to no one when a modern boiler must be erected before the building it will heat can be built around it, and thereafter must remain forever. A well-designed boiler room will, of course, have none of this, and will have a ventilation shaft out through the roof with a corresponding air supply intake through which the ventilating air can enter in adequate quantity, not only to help burn the fuel, but also to conserve the life of the gage watcher. ‡

## the law and your profits

**JOHN F. MORRISSEY, author of this regular feature, is an attorney at law and has an extensive practical business and legal background. This series is based on actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.**

# Under Statute of Frauds Not All Agreements Must Be in Writing

THERE IS a law known as the "Statute of Frauds." It generally provides that a contract for the sale of goods or materials valued at $500 or more (the amount may vary in different states) is unenforceable unless it is evidenced by something written and signed by the party against whom legal action is brought. It can be seen, then, that many oral agreements of purchase, even where both parties admit agreement, cannot be made the subject of lawsuit. The following case illustrates a facet of this law:

The U. Rite Piping Co. had contracted to install a large steam distribution system. In consequence of this anticipated work it entered into a written purchase agreement with the manufacturing firm of Sloe and Sons for $8000 worth of steel pipe. The agreement called for delivery at once."

However, on the back of the purchase order form it was stated that "all orders and agreements must be in writing and they are subject to shortage of material and supplies, labor stoppages, accidents, and other causes beyond our control."

Two months later, Sloe and Sons had not delivered any of the material and U. Rite was experiencing great difficulty in trying to honor its original installation contract. Sloe's excuse for nondelivery was shortage of materials caused by conditions beyond his control.

When U. Rite threatened cancellation, Sloe agreed orally to commence deliveries on a specified date and to complete deliveries within a certain time. But again the deliveries were delayed and, after they were finally made, U. Rite sued Sloe for damages occasioned by the delays.

It was conceded that, under the terms of the original purchase agreement, Sloe could not be held responsible for the delays.

"But," argued U. Rite, "we entered into a separate and independent agreement whereby delivery was to begin on a certain date. Sloe has breached the terms of the agreement."

"Well", replied Sloe, "that agreement is unenforceable — for two reasons: one, there was no consideration for our promise and, two, it was not in writing".

The court disagreed with both on the point that the oral agreement was separate and independent of the written contract.

"Even if it were," said the court, "it did not have to be in writing to be enforceable, because an exception to the Statute of Frauds' requirement, that the agreement be evidenced by writing, is where part of the goods or material is delivered and accepted by the purchaser. The delivery — even though it was late — and acceptance in this case is sufficient evidence of the existence of a contract. "However, the oral agreement was only a part of the written agreement. It did not change or modify the written agreement. It merely clarified the terms with reference to delivery dates which were left uncertain in the orginal contract.

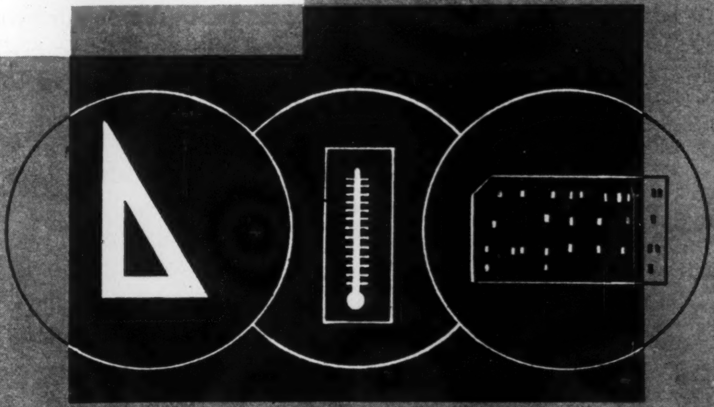
"In other words, it was the parties' expressed understanding of what would, under the contract, be a reasonable time for the delivery which the contract required. No consideration was required for this additional understanding and the Statute of Frauds does not apply".

U. Rite was awarded damages for Sloe's delay. But again this case illustrates the advisability of reducing all contractual terms and subsequent understandings to writing. +

**HPAC ENGINEERING DATA FILE**

# Air Force Engineers Hear Ways to Improve Heating System Operation and Maintenance

- *Key elements in system life cycle*
- *Air Force O and M experience*
- *Economy through water treatment*
- *Selecting the most economical fuel*
- *O and M based new system criteria*



Conservation, through proper operation and maintenance, was the theme of the Air Force Heating and Power Conference held recently at Wright-Patterson Air Force Base under sponsorship of the Director of Civil Engineering, Headquarters USAF. Mechanical and electrical engineers from the 14 major commands and interested visitors from other services, and foreign air forces assembled to exchange experiences and to consider ways to improve the efficiency and reliability of Air Force heating and power installations to reduce, if possible, the $148.2 million bill for operating and maintaining these systems and to insure accomplishment of its primary mission — defense.

It should be remembered that the Air Force is some 13 years young, and that much of its first 13 years have necessarily been devoted to construction of its vast physical plant. Before its establishment in 1947, it occupied space maintained by Army engineers, so its experience in the operation and maintenance field is limited by comparison with other branches of the service. A closer look is being taken at this part of its responsibility and much effort expended to innovate and improve. It has contributed significantly to the development of HTHW systems and presently has systems of this type installed with a total capacity of almost 3½ billion Btu per hr.

Increasing importance of heating, air conditioning, and power in successful accomplishment of the Air Force defense mission is related to the development of new weapons — missiles in particular — in which these ground support systems are an integral part of the weapons systems. This in contrast with the early days in which a runway, an aircraft, and the payload were the only necessities for successful operation.

In this report, we present those papers and discussions related to heating problems encountered and how they are being solved. While many of the remarks are based on Air Force experience and needs, all can be extrapolated and applied to civilian systems. The size of the Air Force plant and its mission serve to emphasize areas where improvement may be needed.

# Air Force Conference Considers Operation and Maintenance of Heating Systems

RESPONSIBILITY for operating and maintaining the vast Air Force heating system rests with Major General A. M. Minton, director of civil engineering, and the many mechanical engineers under his command. During fiscal 1959, the Air Force spent \$82.7 million (\$60 million for 3 basic fuels) to operate and maintain its heating plant and another \$65.5 million for operation and maintenance of power generating facilities, some of which provide heating. The latter includes the purchase of about \$46 million worth of power from public utilities. To improve the effectiveness of operation and thereby obtain more from the men and dollars involved, General Minton proposed the following four pronged attack:

1) Modernization of existing plants — the purpose here is to correct design deficiencies, update equipment, and to install adequate instrumentation to provide operating personnel with the proper tools to operate at peak plant efficiency.

2) Development of an operating award program — to work out a program of awards which will provide group incentive air-force-wide for improving operation and maintenance.

3) Establishment of an operator's licensing program — to provide incentive for self-improvement of operating personnel with a program similar to that of industry. Currently, plant operators need not be licensed except as required by local ordinances.

4) Training of operators — to better prepare and equip them for the increasing operation and maintenance tasks ahead.

The problems and needs are affected, he said, by a transition now in progress in the Air Force. Areas of change include:

1) Increased expenditure of effort to provide better facilities for personnel to live and work in. This is in recognition of the importance of environmental control in personnel efficiency.

2) New weapons present new problems. In the early days, heating and power were not an integral part of the weapon and were given secondary consideration. Now, however, they are an integral part of the weapons system and this requires a higher degree of reliability, continuity of operation, and ease of maintenance not needed earlier in ground support systems.

3) Weapons and supporting installations are being deployed in remote locations. Sources of supply and qualified maintenance personnel are extremely limited at many such locations. This introduces a difficult and complicating problem and further stresses the need for reliability.

4) Operation and maintenance can take only their proportionate share of appropriated dollars. However, requirements for maintenance are increasing at a faster rate than the amount of money available to satisfy them. For this reason, the effectiveness of the heating systems and the operating personnel must keep pace with the increasing needs. Accomplishment of this goal could release funds for the primary mission — defense.

In the conference sessions much progress was made in accomplishing these objectives. Tentative awards and licensing programs were reviewed in seminar sessions and recommendations made for implementing them. It appears that both will become a part of Air Force policy in the near future. The technical sessions were designed to provide information satisfying the objective of improving operation and maintenance. In this report, selected discussions which will be of interest are presented in abstract. These papers also touch upon design and installation as they relate to operation and maintenance.

# The Life Cycle of a Heating Plant

The biography of a plant, according to Prof. P. J. Grogan, chairman of the department of engineering, University of Wisconsin Extension Division, whether a success story or a tale of woe, depends upon what happens to the system in the following four phases: design, installation, operation, and maintenance. These factors depend upon and reinforce one another and there can be no whole without all of the parts, he said.

## Design Phase Scrutinized

"By applying a magnifying glass to design, we see that it actually plays the most important and often most enduring role in the success or failure of a heating plant," Prof. Grogan said. "A closer look shows that design is affected by several factors. Among these are existing *policies* and regulations covering procurement of new facilities, budget, time, and skill. The *budget* is closely related to or dictated by policy. However, once a given amount of money has been established for the project, it begins to affect the ultimate design in ways that cannot be changed without changing the budget.

"*Skill* takes into account the design competence or skill with which the consulting engineers can perform their task. It follows that a highly qualified organization can do much to make a project successful while it is on their drawing boards.

"*Time* takes into account the time table under which a project has to be brought to completion. Perhaps this should take into account distance and environmental conditions as well. For example, a facility in the permafrost conditions of a remote Arctic location should require more time for design than a facility on the flat farm lands of Ohio."

## Erection Sets Manner of Plant Built

"A closer look at the installation phase shows several distinct elements including contracts, erection, run-in and test, and start-up. The *contract* papers include all of the binding agreements between the contractor and the purchaser and must spell out what manner of plant is presumed to be built. The *erection* period comes closer to spelling out what manner of plant is actually built. Where plans and specifications are properly drawn, where the construction superintendent and inspection are competent, and where the contractor and equipment vendors do not openly default, the plant should materialize as planned. The *run-in* and *test* period is critical in that it should assure that each item of equipment is properly installed and can perform at its contract capacity and efficiency. The installation phase normally ends when the plant, complete with all of its auxiliaries, is proved to be capable of operating as planned and is turned over to the regular operating personnel."

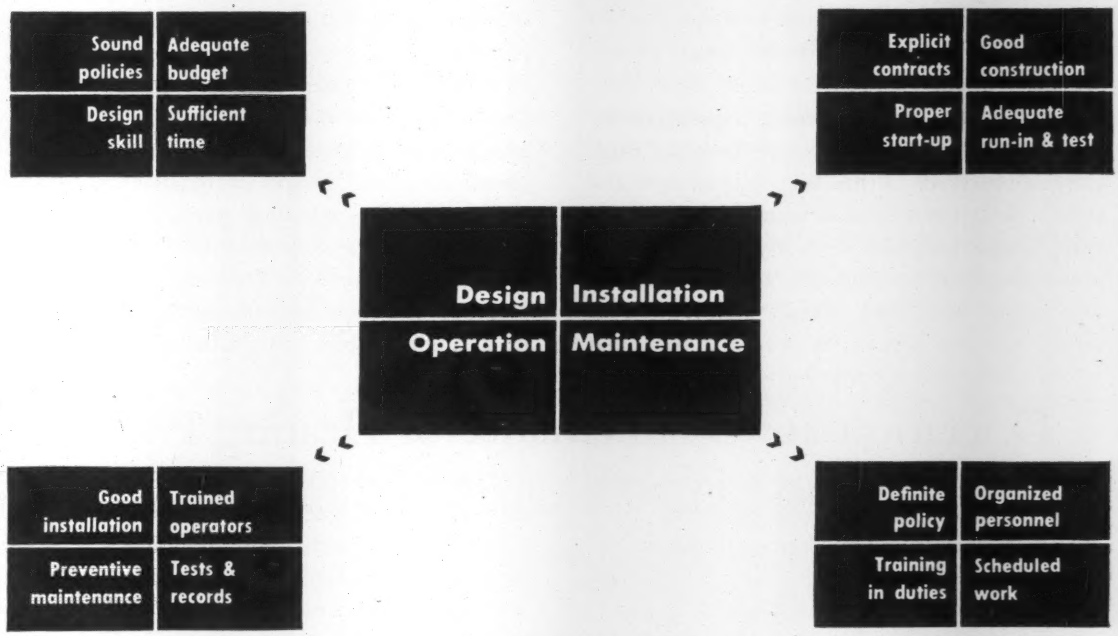
## A Program For Good Operation

"A program of successful operation has four prime elements: good equipment, properly designed and installed; adequate numbers of personnel and a program of operator training for proper handling of equipment involved; preventive maintenance to forestall early and rapid deterioration of equipment; and performance testing and operating records that assure the equipment is in optimum condition.

"This approach to good operation places 75 percent of the responsibility on the person in charge of the plant. Even a faulty installation or poor initial choice of equipment can be largely corrected over a period of extended maintenance activities. Good operation is best described as operation without malpractice or malfunctioning of equipment. Actually, most equipment is rugged and safe unto a factor of 4 or 5 times that which might be considered to be the limit of good operation, good judgment, or good design. Thus, poor operation often goes unnoticed and uncorrected until failure ensues."

## Four Steps to Good Maintenance

"A good maintenance program requires that you implement several steps. These steps are:


Sound policies
Adequate budget
Design skill
Sufficient time
Explicit contracts
Good construction
Proper start-up
Adequate run-in & test
Design
Installation
Operation
Maintenance
Good installation
Trained operators
Preventive maintenance
Tests & records
Definite policy
Organized personnel
Training in duties
Scheduled work

**These elements in each phase of a system's life cycle are essential to success**

establish a definite maintenance policy, organize maintenance personnel with definite assignment of duties, train all persons to carry out their assigned duties, plan and schedule work as much as possible. Records and continuous evaluation should be a part of any successful maintenance program. Without these things, maintenance suffers and this leads to poor service, high fuel costs, excessive replacement costs, and decreased equipment life," Prof. Grogan warned.

"Over the long pull, a maintenance program will be successful if the following tenets are observed: keep an inventory of what is to be maintained; establish the frequency with which each item and each function needs to be inspected; control costs by doing the right amount of maintenance — neither too much or too little; constantly upgrade all aspects of maintenance, such as personnel through training, improved tools and methods, better records and reports, and improved evaluation of program."

## Other Prime Factors in Life Cycle

"Another set of factors that should be given prime consideration in design as well as in other phases of the plant life cycle are; safety, economy, reliability, and simplicity.

"The principal aspects of *safe* operation are covered by existing codes insofar as design is concerned. But the unsafe feature, act, or condition has to be guarded against at all times in the life cycle of the equipment. Operation and maintenance, in particular, afford many opportunities to improve plant safety.

"*Economy* of operation will be affected scarcely at all by installation if the design plans and specifications are followed as to their intent. Neither will maintenance have a great influence on operating economy, at least not in the early years of plant life.

"*Reliability* is an extremely important feature for defense installations, remote locations, and 'round-the-clock operation. As a total facility becomes more complex, the absolute reliability of the system becomes the product of the reliabilities of the several parts. Moreover, improved operating continuity causes more and more reliance to be placed upon the system. The increasing importance of reliability cannot be emphasized too strongly. If it were not for the possible adverse reaction from the taxpayer, reliability should be ranked right behind safety as a prime consideration in building, maintaining, or improving a plant.

"Finally, the idea of keeping a plant simple probably does not receive enough thought," Prof. Grogan observed. "It has been proved over and over in design as well as in nature that the really good ideas are simple. With *simplicity* generally goes reliability, accessibility for maintenance, low initial cost, and overall contribution to safety. On the surface, it would appear that economy of operation, alone, suffers from simplicity. And this may not be the case in the hands of a skilled designer. Simplicity can take many forms. It may mean fewer parts, ease of maintenance, or ready understanding by operating personnel. Certainly, simplicity remains an advantage where the operating personnel are inexperienced or are subject to rapid turnover. A rapid depreciation rate, frequent shutdowns, or seasonal operation bespeak further advantages of a simple system," concluded Prof. Grogan.

# Operation and Maintenance of Heating Plants

The number of heating plant configurations to be operated and maintained by the Air Force is proportional to the number of consulting engineers employed to design the facilities, observed Maynard Rauch, mechanical engineer, headquarters, Air Defense Command. In addition, he continued, the number of ways of operating a given system is proportional to the number of operators called upon to operate it. When an operator is transferred to a new location, operating difficulties often begin and before long design changes are recommended to conform with his experience.

To minimize the operation and maintenance difficulties that arise from this, he recommended that an operation and maintenance manual be prepared for every plant and system. At present, the contractor is called upon to provide this information, but the contractor usually assumes that operation refers to individual pieces of equipment, he said, rather than the operation of the whole plant. Since operation depends upon the design philosophy and intent, preparation of the manual should be a design function, he said. The manuals should include design requirements and intent for individual zones, control diagrams for each system with the operating procedure, control sequence, etc. shown on the diagram, he continued. The latter should be posted near the equipment for which they apply. [*Ed. note: For further details see HPAC Engineering Data File, September 1959 in which similar views and proposed content are presented by W. N. Meyer, Air Force Academy Construction Agency.*]

Contract operation and maintenance has caused some difficulty due to the short term nature of the contracts, said Mr. Rauch. A study of two HTHW plants, he said, indicated that in-service operation costs less than contract operation and results in better supervision [*Ed. note: The Air Force operates and maintains its heating plants both with in-service personnel—civilian and military — and by contract with outside agencies. Contracts are generally renewed annually through competitive lump sum bidding. Thus, there is no assurance that the same contractor will maintain a facility two years in a row.*]

## Two Points to Watch With HTHW

Two points to observe in operating high temperature water plants were noted by Mr. Rauch. The first was that leaks may go unnoticed for considerable periods of time due to the nature of HTHW. With small leaks, he said, there is very little visible vapor. In a quiet environment, a hissing sound may be detected, but, he observed, in a heating plant the noise level is such that leaks go undetected. He cited one case in which leakage occurred in the rolled joints at the juncture of the boiler tubes and external headers, which were insulated and jacketed. Leaks inside the jacket were not detected, he said, since no external sign of moisture was evident. Deterioration of 80 percent of the joints occurred before the leakage was found. The rehabilitation of these boilers will include, he stated, an insulated enclosure which will not be in contact with header or tube, and will provide access and visual inspection.

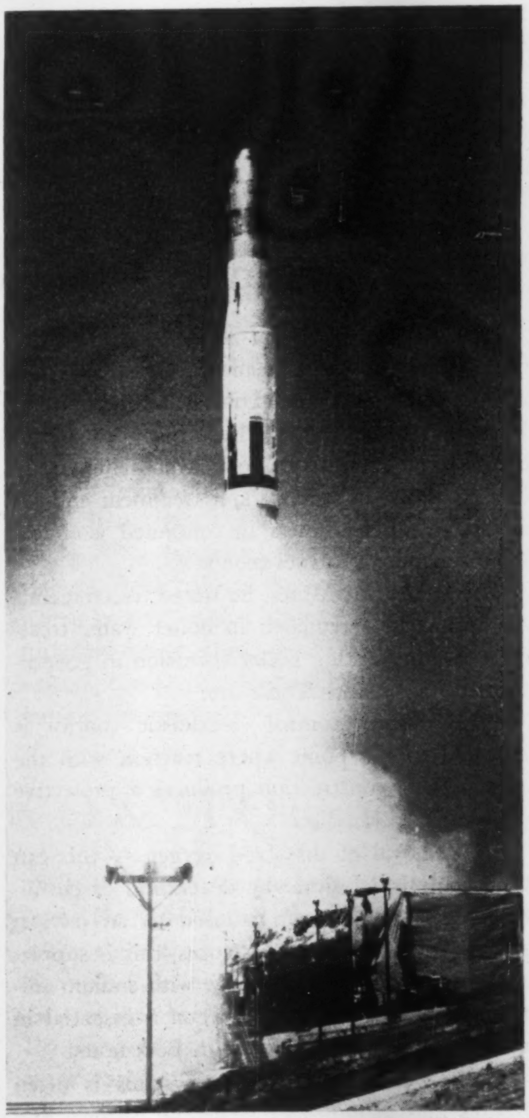
A second problem with HTHW is related to the high heat content of the HTHW. At low flow rates in LTHW converters, he said, the tremendous energy in the HTHW causes a rapid rise of the secondary water temperature and excessive hunting of the control valves. Mr. Rauch suggested that increasing the secondary system water capacity in the converter may resolve this difficulty.

## Heat Boiler Rooms?

Don't overlook the need for auxiliary heating in boiler rooms, warned Mr. Rauch. It is often assumed that extraneous heat gains from the equipment will insure comfortable conditions for the operators. However, he said, during cold weather the operators will often close the windows and doors and cut off the supply of combustion air to the boilers. Intakes can be installed to assure adequate combustion air but the comfort problem remains. Air heating coils can be installed in intakes designed to handle the combustion air, he said, but this can result in subatmospheric boiler room pressures and increased infiltration around doors and windows. This negative pressure can also create a hazardous condition, he said, when products of combustion are drawn into the building through idle boilers or barometric dampers. Another way — also unsatisfactory — is to install unit heaters to heat recirculated boiler room air. This method fails because the comfort conditions are not always satisfactory. The best solution and the one Mr. Rauch recommended is to use 100 percent outdoor air in the amount required for combustion through makeup air heaters. This permits maintaining a positive pressure in the boiler room and provides comfortable working conditions.

## PM Reduces Maintenance Costs

Preventive maintenance has greatly improved operation, increased equipment service life, and reduced maintenance requirements in our installations, said Mr. Rauch. The preventive maintenance practiced consists of periodic inspections, proper lubrication, cleaning of filters, etc., and observation of the general condition of the equipment. Preventive maintenance will not eliminate all failures, Mr. Rauch continued, but it will reduce them and aid in determining what repairs are needed to maintain continuity of operation. He did not consider it to be good practice to have separate preventive maintenance and operating crews, he said. [*Ed. note*: *Cur-*



*(Official USAF photo)*

**NEW WEAPONS** such as this Titan missile demand increased reliability and ease of maintenance in ground support utilities to assure success as these are now an integral part of the weapons system *rent Air Force policy is to separate preventive maintenance crews from the various shops wherever this is feasible. This is based upon past experience and tests conducted at Moody AFB in which the results favored such separation. When only shops exist, it is presumed the mechanics will spend 80 percent of their time on maintenance, and 20 percent on new construction. However, it is often expedient to increase the new construction load, and then maintenance suffers. When separated, the maintenance overload on preventive maintenance personnel is referred to the shops. An informal survey indicated an even division of opinion — in some areas the two groups were being remerged, in others separation seemed to be the answer. It is evident that plant size, method of scheduling, and control affect the choice. The question of how best to schedule and administer preventive maintenance is still being studied in controlled tests and we will be bringing you the results of these as they become available.*]

Mr. Rauch recommended that every central plant be equipped with instrumentation adequate for the purpose of determining plant input and output or overall efficiency. He cautioned, however, that the instruments used for this purpose must be properly maintained and calibrated if the data are to be meaningful. Operating personnel often are not capable of checking and maintaining such instruments and the accuracy suffers, he said. Maintenance of this instrumentation due to its complexity, he said, might best be accomplished through contract with the instrument maker.

# Water Treatment — A Key to Economic Operation

Conservation is defined as the intelligent use of resources by the Bureau of Mines, said Dr. A. A. Berk, chief industrial water laboratory, Bureau of Mines. In this light our approach to boiler water treatment is one which emphasizes fuel economy, he said. Water treatment and resultant boiler cleanliness, he continued, is a most important factor in fuel economy.

The Bureau of Mines, he stated, recommends two principal safeguards in boiler water treatment for preventing boiler corrosion in government owned plants. These are:

1) Alkalinity control — caustic control is adjusted to the point where reaction with the materials of construction produces a protective coating.

2) Removal of dissolved oxygen — this can be accomplished either by deaeration or chemicals. Quebracho tannin is used as an oxygen scavenger and, in some instances, this is supplemented, he said, by treatment with sodium sulfite. Control of dissolved oxygen is essential in package water wall boilers, Dr. Berk noted.

Outage corrosion in many systems is often serious due to improper layup, he warned, and the corrosion originating during periods of shutdown does not always decrease when the system is put back into operation. He suggested that the best solution to this was further education of operating personnel to assure that proper layup procedures were followed.

Intercrystalline corrosion (cracking due to caustic embrittlement) is not found in government boilers following Bureau of Mines water treatment recommendations, he said. This is bacause the treatment specified by the Bureau takes care of it. Quebracho tannin is one of the more effective caustic embrittlement inhibitors, which is a second reason for its use in boiler feedwater treatment, he said.

Condensate or return line corrosion is not as successfully controlled, he said. The Bureau of Mines corrosion tester, which he described as a nipple filled with concentric rings of the piping material, is helping to eliminate this problem, he said. The ability of the concentric ring tester to indicate the pattern of corrosion is its chief advantage over the coil or plate types, he continued. Bureau of Mines studies have shown that carbonic acid is the most important source of return line corrosion. The problem starts with the carbonates in the makeup water, he observed.

Pitting almost always is related to contaminants in the return line, Dr. Berk said. The contaminants are needed to produce concentration cells which cannot occur in flowing pure water.

He noted that most return line pitting is due to improper layup procedures. Water, which remains in the return line during shutdown, he warned, becomes impure locally and sets up the necessary conditions for the formation of concentration cells.

A successful return line survey to determine the adequacy of boiler water treatment, according to Dr. Berk, depends upon selection of a representative sampling station. Since the concentration of carbonic acid increases with increased steam condensation in the distribution piping, the maximum concentration of carbonic acid is usually found in the last building along the main. Although it does not always follow, he said, sampling near the end of the main will indicate the adequacy of treatment at all points along the main if a limited survey must be made. However, it may be desirable to sample at other points too, he said.

Answering the question of what to do about return line corrosion, Dr. Berk recommended removal of the carbon dioxide as the best way to control it by:

1) Designing and operating to minimize make-up water requirements.

2) Maintaining deaerators in top condition since good operation of the deaerators eliminates carbon dioxide as well as oxygen. The pH buildup that results from this, he said, is beneficial in protecting feedwater pumps, valves, and piping from corrosion.

A split stream cation softener will remove most of the carbonate in the makeup water, he said. However, he observed that they must be regenerated periodically to accomplish their mission. He cited one case in which the operating personnel did not regenerate the softening equipment with unsatisfactory results as would be expected.

He suggested that the next best way to control return line corrosion is chemical treatment of the feedwater to neutralize carbonic acid in the condensate. Neutralizing amines, morpholine or cyclohexylamine, are used for this. When positive control is not practical due to high makeup water requirements, etc., he suggested the use of filming amines. He did not place much reliance on the ability of filming amines to control return line corrosion because of doubts about its ability to coat the return line completely. In addition, he noted that the probability of good film formation is decreased through decomposition of the filming amines.

The effectiveness of the Bureau of Mines control recommendations was illustrated by Dr. Berk by comparing losses due to corrosion before and after the recommended control was applied. In systems containing a total of 15,000 boilers, one Agency reported that annual return line corrosion losses amounted to about $2½ to $3 million a year before tester survey and treatment. After treatment, the losses in the same systems were reduced to $¾ million. He estimated current annual savings in the cost of return line corrosion in systems under the jurisdiction of the Department of Defense at over $5 million per year.

# Heating Panel Answers O & M Questions

- *When replacing steam condensate lines should the use of copper or copper alloy piping be considered?*

R. J. Felix, headquarters USAF, noted that at present these materials are not included in Air Force piping specifications. However, the specifications are currently being revised, he said, and copper and copper alloys will be given consideration.

Dr. Berk noted that some unfortunate experiences had resulted from the use of these piping materials due to the wall thickness of the pipe used. He warned that the pipe wall thickness and weight are extremely important considerations. Installation of copper alloy return lines, he said, has been in the direction of using the lightest pipe available that will meet the structural requirements. Since these materials will corrode under some conditions, their life depends upon wall thickness, he observed. Both copper and copper alloy piping will stand up, he said if the pipe is heavy enough to permit initial cor-

"A pressurized water loop has been built to study corrosion and erosion of materials used in HTHW systems . . . . . "

rosion without causing leakage. Ammonia and amines can be used for corrosion control in these lines providing the alkalinity does not increase locally and destroy the protective film, he said. The ammonia concentration would have to establish a pH of at least 9 to give trouble, he said. However, a lot of carbon dioxide, a little ammonia, and a little oxygen can be disastrous, Dr. Berk warned, with copper alloy piping. [*Ed. note: The results of an investigation of the corrosion of copper and its alloys and ways to control it are given in the series of articles by M. J. Obrecht and L. L. Quill in recent issues of Heating, Piping & Air Conditioning.*]

● *What is the Bureau of Mines doing with regard to water treatment in high temperature hot water systems?*

This question referred to plants in which HTHW generated in forced circulation boilers is used as a primary heating medium to generate LTHW for use in space heating. Dr Berk replied that a pressurized water loop has been built to study corrosion and erosion of materials used in HTHW systems and to evaluate methods of water treatment. At present no recommendations are available. A survey of various segments of the industry in regard to acceptable water treatment for boilers and various materials has produced limited results and insufficient data on which to recommend what kind and how much treatment is necessary, Dr. Berk said. None of the information obtained relates to the cascade system, he said. This system, in which HTHW is generated by direct contact of recirculated water and steam generated in conventional steam boilers, is presently in limited use by the Air Force. Dr. Berk noted that water quality that has been used for steam boilers may cause disastrous results in the HTHW distribution system if copper or its alloys are present.

A brief description of the combined power-HTHW generating plant under construction at the Ernest Harmon Air Force Base prefaced a question on how to treat the water in this type of system. Steam extracted from condensing turbines will be used to generate HTHW in cascade heaters. Dr. Berk suggested that this type of system would have many problems in operation. Without knowing all of the conditions of operation it would be difficult to suggest a method of water treatment, Dr. Berk said, but that practical freedom from corrosion could probably best be achieved by area control in such a system. In area control, various treatment methods are applied in different parts of the system in accordance with their specific needs rather than trying to prescribe a single method of control for the entire system.

# Instruments and Controls for Economical O & M

Adequate instrumentation and controls are important tools for accomplishing economical and continuous operation, said Russell Attridge, Minneapolis-Honeywell Regulator Co. Instrumentation provides the means of monitoring plant operation to assure that it is always operated at peak efficiency for a given load condition. Controls will eliminate the excessive overheating and fuel loss which is common in many heated Air Force spaces not presently under automatic control, he said.

Controls can also reduce operating personnel requirements, he said, in describing an alarm surveillance system developed by industry at Air Force request to eliminate the requirements for roving personnel to check the operation of small and widely scattered boiler plants.

Many such alarm systems are now in operation and the conditions under which they are applied by the Air Force and how they operate are given below.

The alarm indicating system as noted by Mr.

Attridge was devised to eliminate frequent visits by roving personnel to check operation of heating plants. As the alarm surveillance system will monitor plant operation, operators made available by this are reassigned to maintenance duties. Since personnel must be available to correct malfunctioning or failures, a completely automatic or remotely controlled system is not considered justified. The alarm indicating system is primarily intended to improve utilization of personnel and not to function as a safety device.

## Six Functions Monitored

The surveillance system utilizes a telephone circuit to transmit alarm signals to a central location. Six functions can be monitored which either directly or indirectly reflect conditions that may be unsafe for continued boiler operation. The six functions in Air Force heating installations are:

1) *Combustion control* — Any burner over 720,000 Btu per hr input not constantly attended must be monitored by a flame monitoring device. All of these controls are designed to shut the burner down in the case of flame failure and have, or can be equipped with, contacts to relay to a remote point that flame failure has occurred.

2) *Low water level* — All steam boilers are equipped with low water level controls. The controls contain or can be equipped with alarm contacts. These contacts close when the feedwater system is unable to maintain the proper water level.

3) *High and low pressure* — Should any part of the combustion control circuit fail to function and the boiler pressure rise too high or fall too low, operator attendance is required immediately. These alarm functions can be accomplished by adding high and low pressure cut-outs at the same location as the existing control. The latter is then not affected.

4) *Power failure* — Any failure of power due to an open circuit breaker, blown fuse, or any other condition peculiar to the plant can be monitored. All circuits serving the alarm system should be protected by properly rated thermal magnetic circuit breakers and no other equipment should be connected to the alarm circuit.

5) *Low space temperature* — A low space temperature alarm circuit actuated by a room thermostat is provided.

6) *Low gas pressure* — On boilers and furnaces where gas pressure is critical, low or high gas pressure can be monitored. Only the burners at points in the distribution system where low gas pressure is apt to initially occur need be monitored.

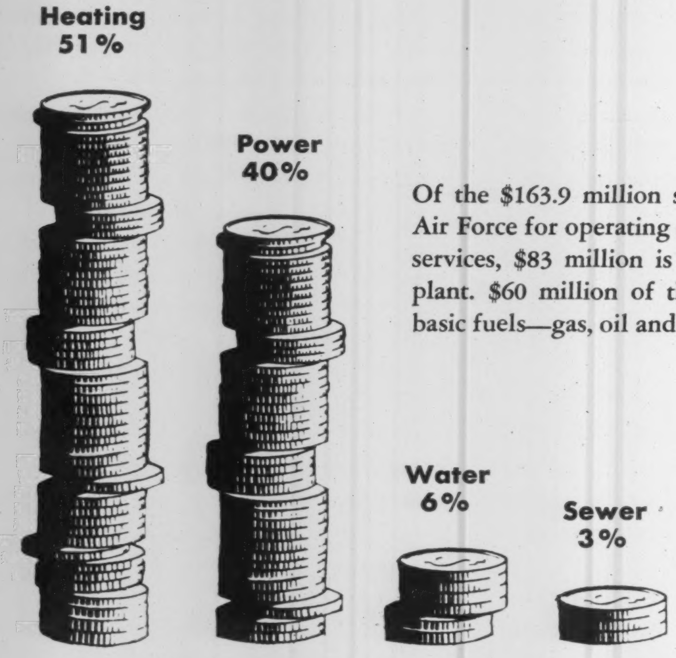
The Air Force estimates material costs at $100.00 each for panels located in the heating plant and $500 for the panel in the central surveillance center for each group of four remote plants. Fifty dollars is added for each module. To this must be added all wiring costs exterior to the panel. The average total cost for connecting each boiler plant in a complex varies with the number of boilers but is estimated to be about $600.

The alarm system is adaptable to other systems, too. Refrigeration components in air conditioning systems can be monitored for low oil pressure, and undesirable temperature and pressure relationships. Water pumps that are started and stopped from remote locations can be connected to the surveillance system, as can other remotely operated equipment. In most instances, the alarm system is suitable for indicating if freezing damage is probable.

# Fuel Selection, Quality Control Affect Economy

The Air Force spends approximately $60 million a year for the three basic fuels to provide heat for the widespread facilities, said H. S. Ivins, headquarters, USAF. This, he said, is the largest single utility expenditure.

"Fuel selection may appear to be a very elementary function, but there are many factors which must be considered. The fuel market is continuously changing. New sources of fuel are being developed, other sources are becoming depleted. Improved reclamation and processing techniques as well as changing transportation



Of the $163.9 million spent annually by the Air Force for operating and maintaining these services, $83 million is spent for its heating plant. $60 million of this is spent for three basic fuels—gas, oil and coal

*HERE IS HOW THE AIR FORCE SPENDS ITS UTILITY DOLLAR*

costs have major effects on arriving at an intelligent, unbiased determination of the best fuel to use," Mr. Ivins said.

The word best, he continued, is used to preclude the acceptance of a fuel on the sole basis of lowest initial cost. The cost per Btu of fuel delivered is important, he said, but there are many other considerations which must be explored to assure an accurate economical conclusion.

"Competition is keen in many areas between producers and suppliers of the major heat sources. In some sections, however, the use of a certain fuel may be taken for granted. Although, it is not desirable to convert frequently from one fuel to another, current information should be maintained regarding sources and costs of fuels, including transportation and the reliability of delivery," Mr. Ivins said.

## These Six Items Affect Fuel Cost

We are considering oil, gas, and coal as our basic heating fuels in this discussion, he said. Comparisons of operating costs using any of these fuels must consider all items contributing to the operating cost for each fuel. A firm, realistic determination of the most economical fuel, he noted, must consider the following cost items for each fuel:

1) The total quantity of fuel required, which can be determined from the heat content of the fuel and the utilization efficiency.

2) Transportation costs whether by common carrier or by military vehicle.

3) The cost associated with the storage or stockpiling, and distribution of fuels must be estimated or obtained from actual cost records.

4) Where thawing or preheating of a fuel is necessary, the expense connected with this should be considered.

5) Ash or residue disposal, as well as maintenance materials and equipment are items which will naturally vary with different fuels and the relative costs are important.

6) When a conversion is contemplated, all expenses relating to the change, including purchase of or removal of equipment, new distribution lines when required, and modifications of property must be determined.

"With this information the economic study can be completed," Mr. Ivins continued. "The results of this study will be the significant factor in determining the preferred fuel," he said. "This, however, must be correlated with the immediate and future availability of fuels before a final decision is made."

Mr. Ivins then reviewed reports of fuel reserves and changing costs, and concluded that the future availability and cost trends of the various fuels require serious consideration in arriving at a decision for the selection of the best fuel.

### Should Sample, Analyze Coal

The chemical and heat content of the different grades of oil and of natural gas have been fairly well standardized, Mr. Ivins noted, and can readily be controlled. Therefore, he said, there is no requirement for continuous sampling and analysis of these fuels by the Air Force.

The numerous classes, grades, and sizes of coal, however, present a different and more complex problem, he said. To assure that coal is specified correctly, compatible to the combustion equipment, and that the specified coal is received, he continued, a quality control is required. This control is achieved, he observed, by sampling and analyzing the coal received at Air Force installations. He stressed the importance of following accepted procedures in sampling and noted that the end result of inadequate sampling was acceptance, in some cases, of inferior coal with resultant decrease in combustion efficiency and increased operation and maintenance costs.

## Panel Answers Fuel Related Operation Problems

Following the paper by Mr. Ivins, a panel of Air Force and industry personnel answered questions from the floor. Some of these are given below.

- *What effects do improper fuels have on heating plant performance?*

Mr. Ivins answered briefly and pointedly that poor operation and higher operation and maintenance costs would result. E. J. Lundgren, Air Force heating consultant, expanded on this and noted that improper fuels have other ramifications in regard to plant operation. It will increase maintenance costs, he said, and can result in inadequacy of the plant at design conditions. In the case of coal fired systems, he continued, it may cause a fuel and ash handling problem. For example, if the ash content is greater than that for which the plant was designed, more coal and more ash would have to be handled, he said. This extra load might exceed the plant's ash and coal handling capacity. Mr. Rauch warned that coal gradation can be as important as the ultimate analysis. If not carefully controlled to plant requirements, he said, inefficient firing and stoker problems can occur.

- *What is being done to reduce coal transportation costs?*

The railroads are reevaluating their costs for handling various commodities, answered G. L. Coryell of the National Coal Association, and this has resulted in a decrease in rail freight rates in some areas. Coal pipelines have proven successful, but they have limited scope, he said. Truck and rail cartage are still the major means of transporting coal, he observed. Another means of reducing overall fuel costs through reduction of handling costs, he said, is to have the vendor "spoon feed" the plant coal requirements to eliminate double handling and storage. This requires careful scheduling of delivery, but it has been successful in reducing costs in several installations, he concluded.

- *Why are eastern oils easier to burn than those from the midwest?*

Because midwestern crudes are generally thermally or catalytically cracked was the reply of Prof. C. H. Pesterfield, Michigan State University, who represented the Oil Heat Institute of America. Although Mr. Ivins had suggested that fuel oil compositions were standardized and need not be analyzed, Prof. Pesterfield recommended that fuel oil shipments be analyzed to determine the composition of the oil delivered. This is because composition, especially in the heavier grades, varies widely due to the source of the crude and the cracking required. Knowing the composition of the oil delivered will aid in maintaining efficient combustion and will insure that the oil obtained meets the specifications.

In response to a request from Prof. Pesterfield, Mr. Deming described instrumentation his group had developed for analyzing fuel oils. Mr. Deming noted that they had been experiencing uptake corrosion in their stacks which was traced to the sulfur content of the oil burned. To permit analysis of sulfur content, instrumentation was developed which is now available at a cost of about $350.00. The instrumentation is designed so that semi-skilled employees can determine sulfur content in about 15 minutes, he said. At present the Navy is looking for oil additives to neutralize the sulfur based acids in the flue gases to control uptake corrosion. Instrumentation of the kind developed was necessary to evaluate the effectiveness of the additives. Further information about this instrumentation can be obtained from Mr. Deming, Bureau of Yards and Docks, Washington 25, D.C.

In addition to the above instrumentation, the Navy has contracted with the Armour Research Foundation to design an analysis procedure and necessary instrumentation for determining total fuel oil quality, Mr. Deming said. Instrumentation developed in this project is available for a cost of about $2000.00. Four hours are required to analyze one sample, he said.

- *When must No. 5 and 6 oils be pre-heated?*

Both grades 5 and 6 require preheating for atomization, said Prof. Pesterfield. Only No. 6 requires preheating for pumping as a general rule, but this depends upon local conditions, he said. In the midwest, he continued, grades 4, 5, and 6 may require preheating for pumping. The pour point of the oil and the temperature of the storage facility are determining factors, he said.

- *Should we buy oil with additives?*

Any additives used should be added at the refinery to insure proper mixing, Prof. Pesterfield said. Bureau of Mines reports, he added, show that this is the only way to add them. The cost of additives will increase the cost of oil about 1/4 cents per gal, when refinery added, he said. Blending of No. 2 and No. 6 oils to produce No. 5 should also be done by the refiner, he continued, to insure that blending and not mechanical mixing results. Blending requires mixing of the two grades under fairly rigid requirements of temperature and pressure to prevent separation in storage. When oils are simply mixed in storage, he concluded, the No. 2 oil will float.

- *Are additives available for fuel oil to reduce soot and disperse water from condensation in storage tanks?*

Such additives are available, but for best results they should be added by the refiner, cautioned Prof. Pesterfield.

Mr. Deming agreed that something could be said for fuel oil additives, but observed that practically no information is available at present to properly evaluate their worth. Studies are needed, he said, to correlate the effectiveness of additives with the concentrations added for various oil compositions.

As an example of what they can do, Mr. Deming cited a case in which residual carbon collecting in the stacks of a plant dropped on a nearby electronic laboratory. Complaints were registered and the system investigated. Mr. Deming felt that plant operation was not up to par and recommended changes in the plant operating procedure.

After some time without improvement, a mechanical precipitator was purchased to collect the offending pollutant. However, prior to installation of the precipator a new operator took charge of the plant, he said. The new operator recommended the use of an additive that breaks the surface tension of the oil. This produces smaller oil globules — better atomization — and eliminates the production of residual carbon which is caused by radiant heating and cracking of the larger oil globules. To date the precipator has not been installed, he said. However, the old problem of soot production and precipitation on the electronic laboratory is back as the successful operator has left. This experience demonstrates, he said, not only the potential effectiveness of additives, but the importance of good operation as well.

- *Are there additives for reducing soot production of coal?*

Mr. Coryell noted that combustion engineers at present do not consider the use of coal additives to be practical. The National Coal Association, he said, takes no official position in this regard. The Navy and the Bureau of Mines, he stated, are considering a research project to test the value of coal additives under controlled conditions. At present, however, there is no data available, he said, to show how effective additives can be.

# Air Force Heating Criteria for New Construction

The fundamental criteria is to provide systems that meet the specific requirements of the Air Force mission with maximum reliability and minimum overall cost, said R. J. Felix, headquarters, USAF. The criteria for new construction reflect, he said, field experiences in military installations by Air Force headquarters and command personnel, prior experience in the commercial industrial fields, and evaluation of the operation and maintenance costs for the 13 year Air Force experience.

The central plant heating concept was adopted, Mr. Felix said, to eliminate manpower problems associated with individual plants and difficulty in training operating personnel. Also, estimates indicated that as much as 30 percent of the fuel burned in multiple plant installations was lost through overheating, he continued. The central plant, in addition to other gains in economy, he said, also permits the use of the most economical fuel in any given area.

## Why They Use HTHW

In 1949, Mr. Felix said, the HTHW concept was adopted. "This was based on high maintenance costs of steam systems such as high fatality rate of condensate return lines, high losses of steam due to flashing, and inability to obtain reasonable efficiencies from steam boilers operating at low capacities," he continued. When properly designed and when proper materials are

*(Photo by Western Electric)*

DEW LINE sites were first successful Air Force installations employing waste heat recovered from diesel generators for space heating. Remote sites such as this emphasize the need for consideration of reliability, and ease of operation and maintenance in design installed, he said, the following results should be obtained with HTHW:

1) Plant and systems cost less than steam.

2) Smaller boiler plant buildings result when using compact forced circulation boilers.

3) Lines are smaller than for comparable capacity steam mains and ground contour does not present a problem though lines must be pitched to insure proper drainage.

4) A minimum of 20 percent savings on fuel consumption which is due to characteristics of HTHW forced circulating boilers. Tests have proven that these boilers operating in the capacity ranges of 25 to 100 percent have a relatively flat efficiency curve with 1½ to 2 percent deviation between the 25 and 100 percent ratings. This is based upon an average of all fuels used, which includes coal, oil, and gas.

5) Lower boiler maintenance due to longer life of fire side steel and refractory, because the units can be steadily fired, thus minimizing expansion and contraction, and the difficulties that result.

6) Little water treatment is required unless high makeup water requirements exist. (High makeup water requirements have been traced to the use of HTHW for washing aircraft, autos, clothes, etc.)

7) Elimination of distribution system accessories and concentrating pumping equipment in the central plant results in lower maintenance costs.

These are the reasons for using HTHW insofar as the Air Force is concerned, Mr. Felix said.

## Central Plants Cut Fuel Costs

A review of the progress made and the impact of the central station concept is indicated by fuel consumption data given by Mr. Felix for 1949 and 1958. The comparison is based on a standard ton of fuel (25 million Btu per standard ton) consumed per installed equivalent boiler horsepower. Fuel consumption for 1949, with 400,000 hp installed, was 6.4 tons per hp per year. In 1958, with 1½ million hp installed, the fuel consumption was only 3.4 tons per hp per year, he said.

Present Air Force heating criteria specifies circulating hot water in lieu of steam for all permanent buildings with heating loads greater than 150,000 Btu per hr, Mr. Felix noted, unless the process steam load is greater than the heating load. This recommendation is predicated, he said, on the ease of controlling circulating water systems, less stringent maintenance requirements for economy, and the possibility of designing for full perimeter heating.

## Use Radiant Floor Panels in Hangars

Hangars are currently heated with hot water radiant floor panels supplemented with floor type unit heaters in locations with design temperatures zero F or below, he said. Floor type unit heaters alone are used in warmer climates. The intent here is to heat only the occupied zone, he said. Two hangars for B-36 aircraft in northern states have been successfully heated with the floor panel-unit heater combination, he said.

## Use Diesel Waste to Heat, Cool

Waste heat from diesel engines in *prime* power diesel generating plants can be utilized for space and water heating, cooking, and even cooling, through the use of absorption refrigerating units, Mr. Felix said. The first major Air Force use of waste heat from diesel engines was on the DEW Line where it has proven highly satisfactory, he said. [*Ed. note*: *See "Waste Heat Recovery System Keeps Arctic Outpost Warm," by H. Vaugle, HPAC, Feb.* 1959].

In Air Force waste heat recovery systems, the jacket water has been limited by design to a maximum of 190 F and jacket pressure to a maximum of 15 psi. These limits were set by the generator manufacturers. However, a jacket water temperature as high as 250 F can be, and has been used when necessary, but the higher operating temperatures must be included in the generator specifications.

Steam generated in wet mufflers is used directly for heating or, in some instances, to generate medium temperature hot water in contact heaters. The steam is also used for absorption cooling to give a better balance between the electric and steam loads.

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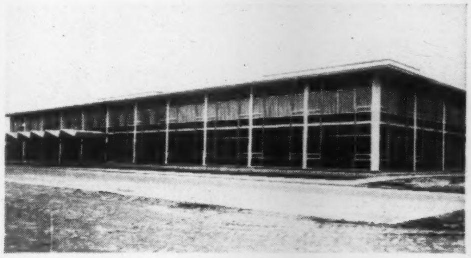

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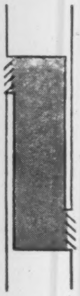

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| W-5 | 7″ | 30″ | 48″ |
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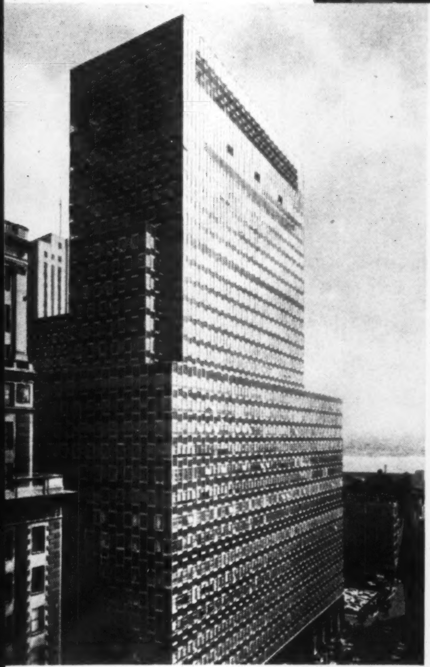

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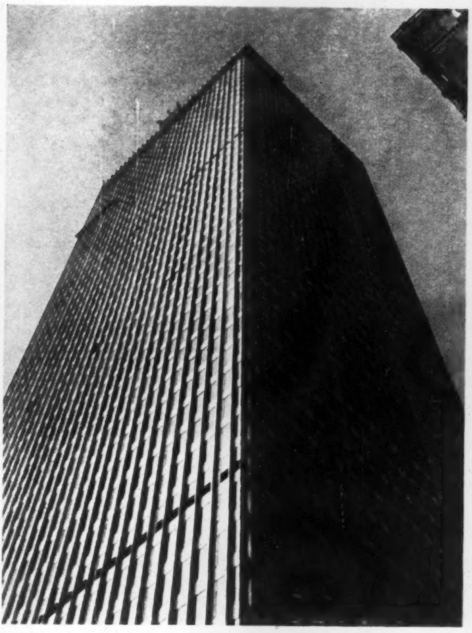

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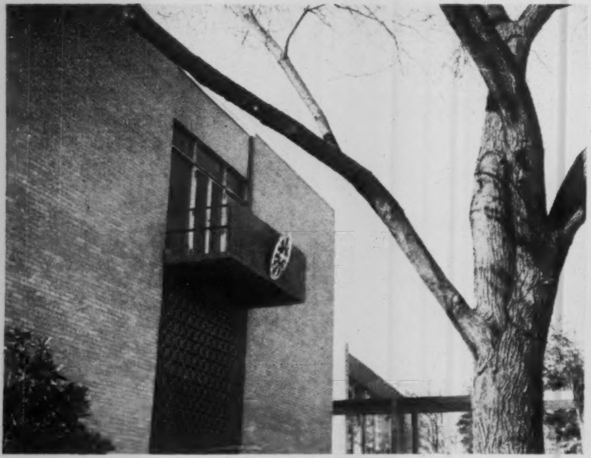

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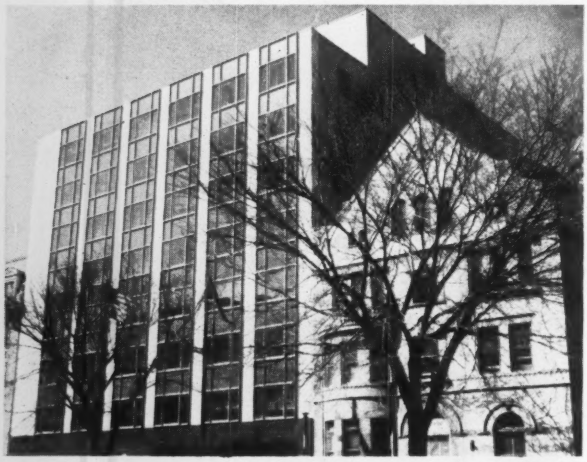

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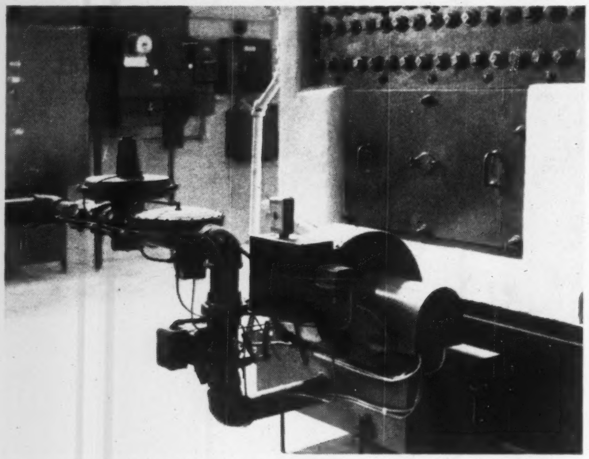

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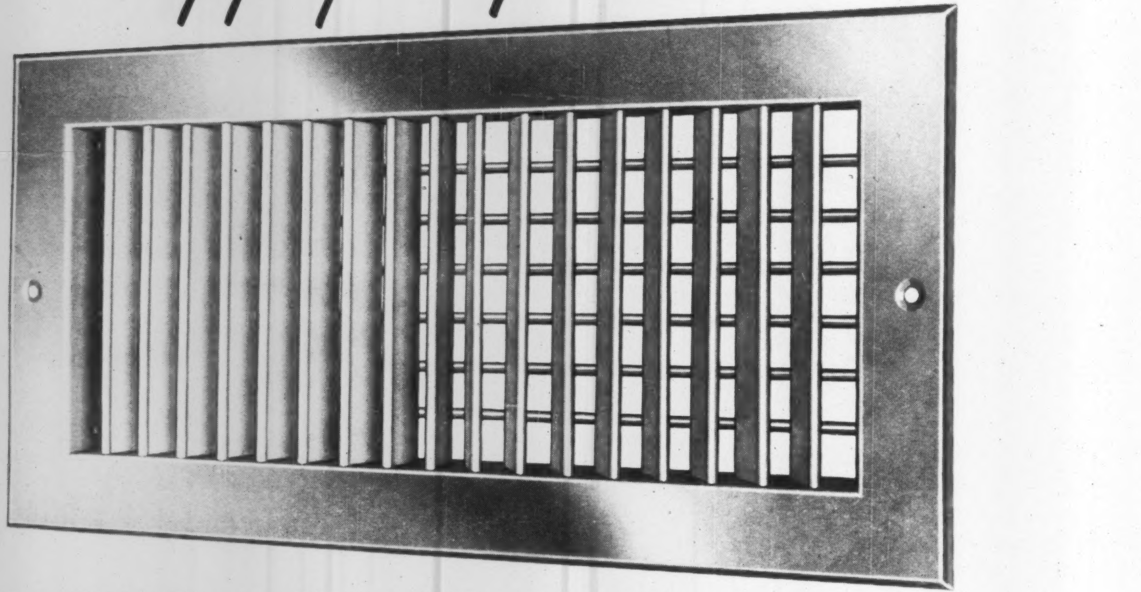

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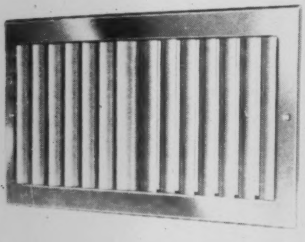

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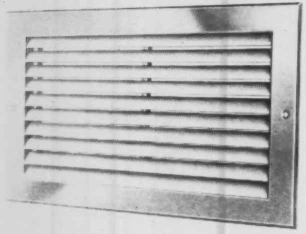

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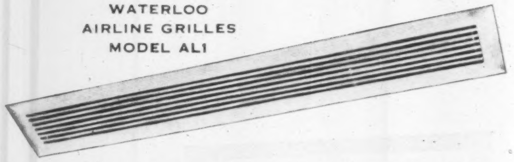

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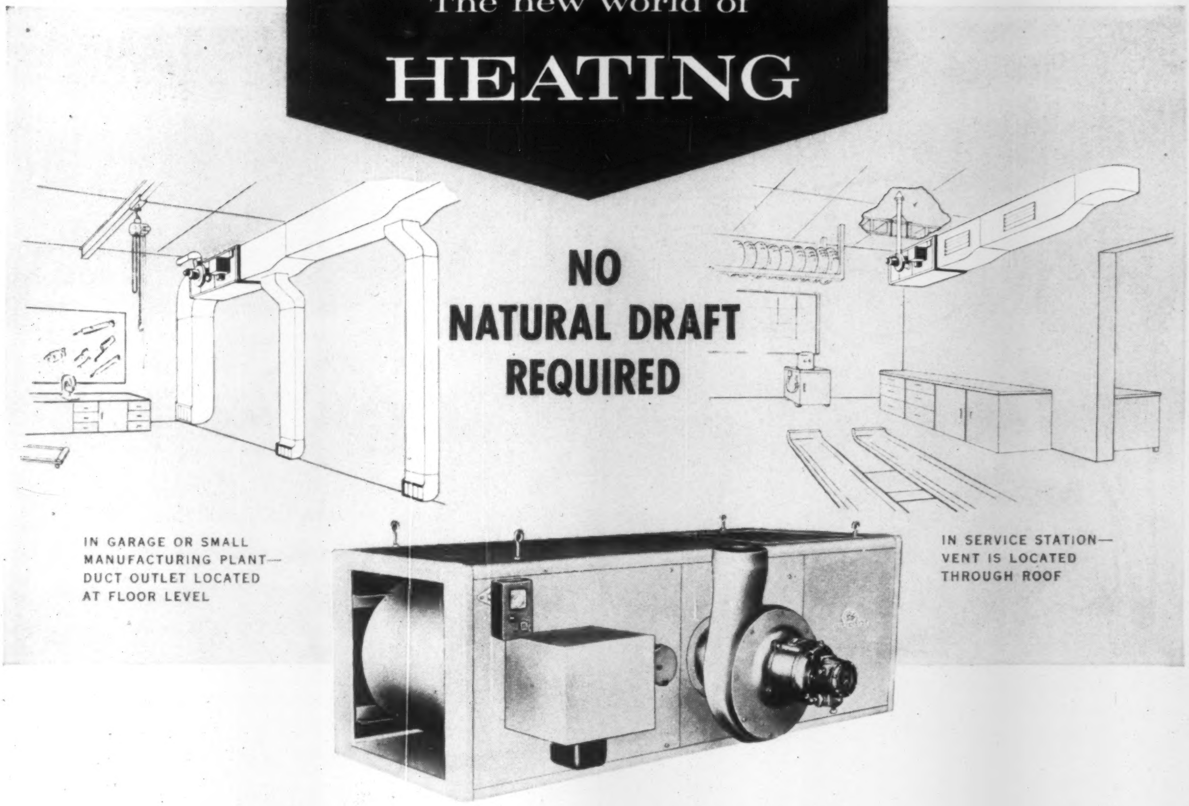
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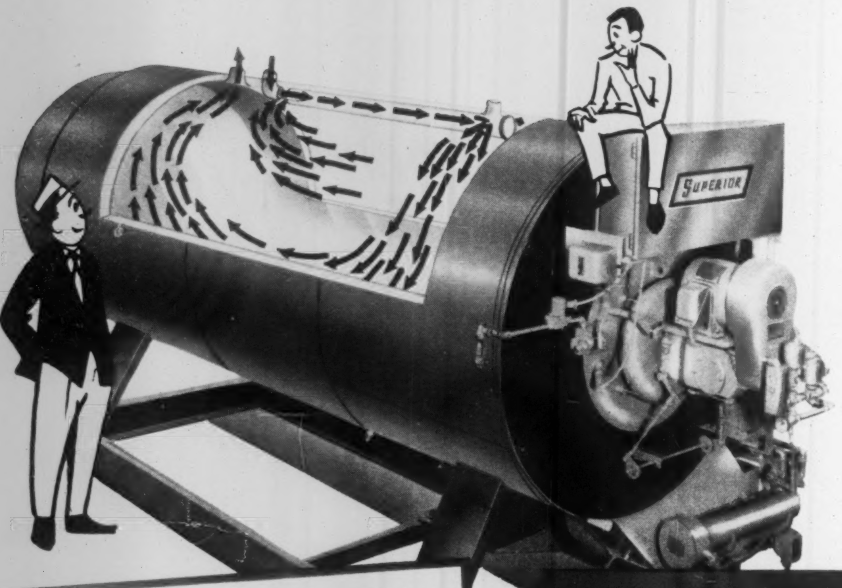

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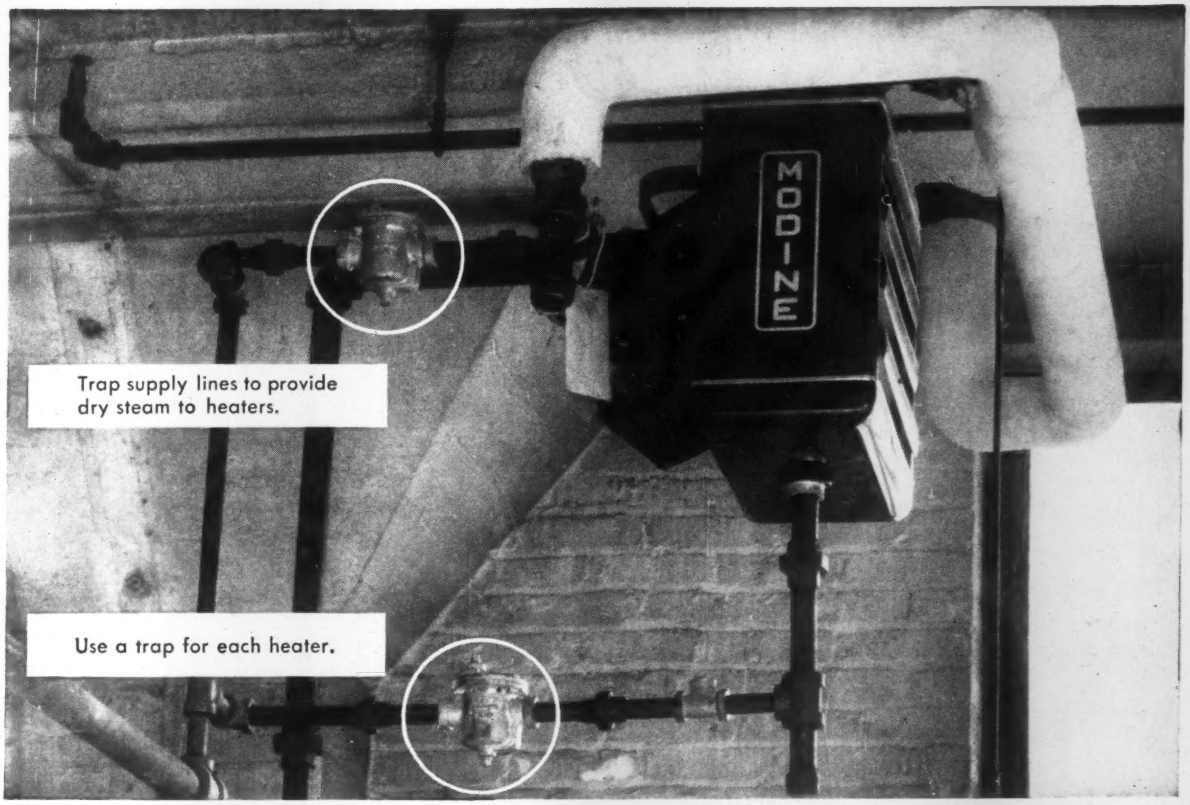
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Trap supply lines to provide dry steam to heaters.
Use a trap for each heater.

# Tips on Trapping Unit Heaters for Full Output and Low Maintenance

• If unit heaters are clean and the steam supply and return lines are adequate, their performance will depend entirely upon the steam trapping. Here are some trapping pointers to insure plenty of heat when it is needed:

**1. Trap supply lines** to take care of condensate formed by radiation loss.

**2. Use one trap for each heater.** Two or more heaters drained by a single trap will fail to deliver maximum btu output.

**3. Size traps properly.** Many a unit heater is handicapped by a trap lacking adequate condensate and *air* handling capacity. The few dollars extra for larger traps insure fast heatup, full output and freedom from coil corrosion.

**4. Install traps correctly.** Put trap below and close to heater. Install a bypass around the trap if the heater must be kept in operation at all times. A shut-off valve in the discharge line facilitates trap inspection. Use of check valves and strainers is dependent upon piping conditions and the traps used.

**5. Protect against PRV failure where freezing could occur.** Sometimes heaters supplied with reduced pressure steam are installed where freezing could occur if traps failed to open. In this case select traps that will open at maximum steam supply pressure and still have adequate capacity at reduced pressure.

**FREE ON REQUEST—COMPLETE INFORMATION on the above points, diagrams, selection data, tables and additional recommendations are contained in Armstrong Bulletin No. 252. Also includes BTU output ratings for all models of 30 makes of unit heaters. Call your local Armstrong Factory Representative or write direct.**

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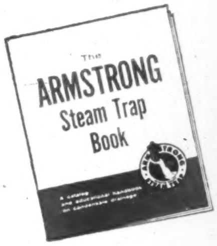

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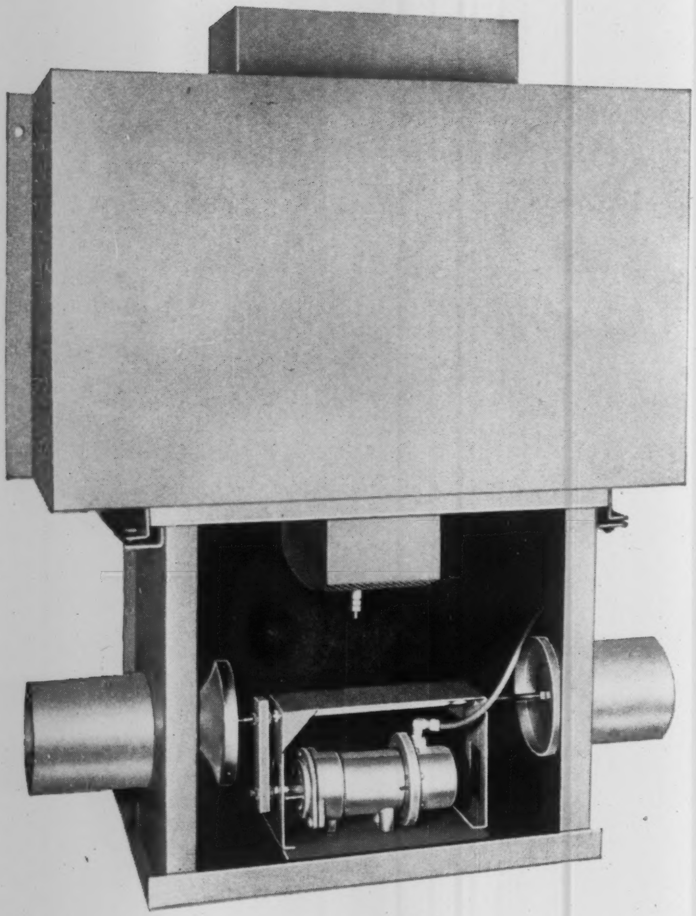

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The mixing valves proportion the hot and cold air in response to the room thermostat and the unique AGITROL volume regulator guarantees constant control of air delivery at the required volume.

Comprehensive noise attenuation tests were conducted to assure extremely low sound ratings for ceiling and under the window units. And for noiseless, draftless distribution of the conditioned air from these units, there is a complete line of AGITAIR diffusers and grilles from which to choose.

Technical catalog HV-100 contains complete performance data and dimensions on all AGITAIR units. Write for your copy today.

## FEATURES

1. One motor — no linkages.
2. Aluminum inlet valves driven directly — instantaneous response . . . no lost motion . . . no backlash.
3. Unique AGITROL valve (constant volume regulator) actuated solely by the supply air.
4. Both mixing and attenuation chambers fabricated of galvanized or galvannealed steel . . . sealed to prevent air leakage.
5. Split fabrication of attenuation chamber permits dimension adaptation to meet most space limitations.

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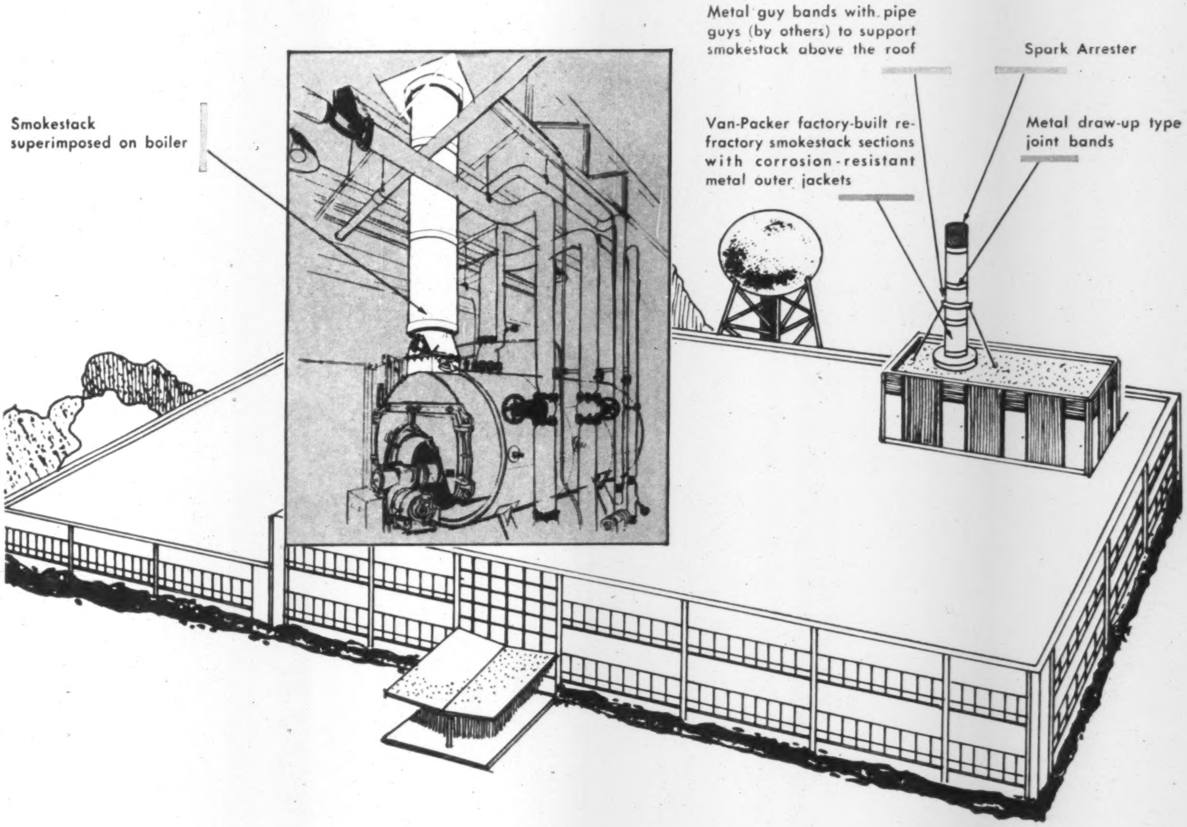
*BETTER PRODUCTS FOR*
*AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST*

# Flintkote • Van-Packer factory-built refractory smokestack outlasts steel stacks, costs no more


Smokestack superimposed on boiler
Metal guy bands with pipe guys (by others) to support smokestack above the roof
Spark Arrester
Van-Packer factory-built refractory smokestack sections with corrosion-resistant metal outer jackets
Metal draw-up type joint bands

The Van-Packer Model HT Smokestack is the *only* industrial stack listed under the Factory Inspection and Label Service Program of Underwriters' Laboratories, Inc. It handles boilers, furnaces and incinerators. Van-Packer Smokestacks consist of factory-built 3-foot refractory sections with corrosion-resistant metal jacket and fittings. They cost about the same as steel stacks for comparable applications, yet last far longer. They require no painting or maintenance. Van-Packer Smokestacks are available in eight inner diameters: 10", 12", 15", 18", 21", 24", 30", and 36". See "Smoke Stacks" in the Yellow Pages for your nearest Van-Packer Distributor/Erector, or send coupon for full information.

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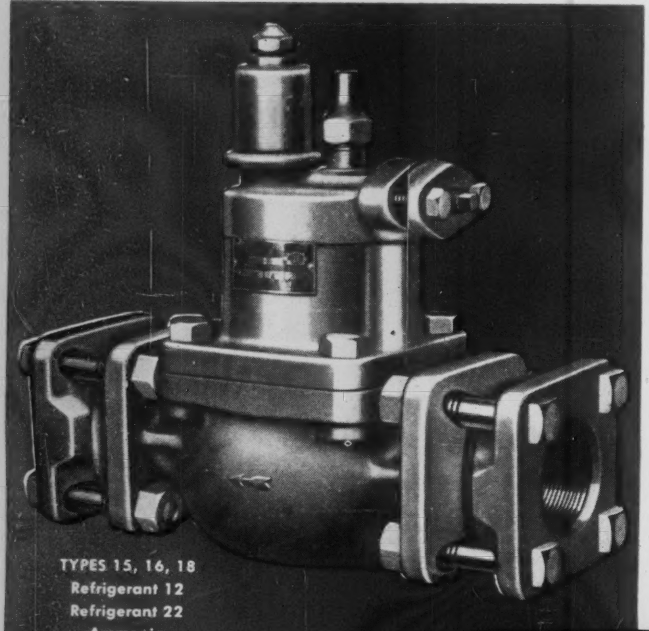
# ALCO EVAPORATOR PRESSURE REGULATORS



TYPES 15, 16, 18
Refrigerant 12
Refrigerant 22
Ammonia

*Your protection from freeze-up*

- SODA FOUNTAINS
- BEVERAGE COOLERS
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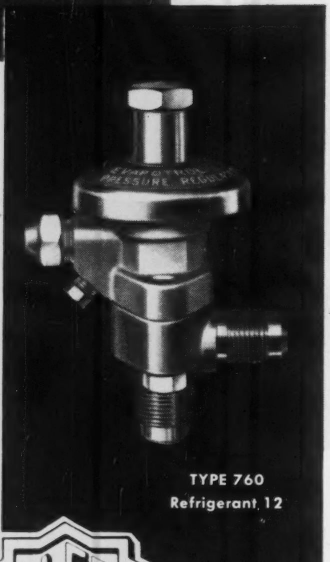
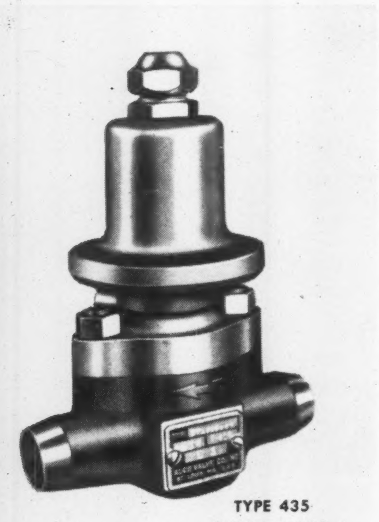
- WATER CHILLERS
  *—from the smallest to the largest*

*Eliminates tube bursting*



TYPE 760
Refrigerant 12



TYPE 435
Refrigerant 12

ALCO'S EVAPORATOR PRESSURE REGULATORS are designed, engineered and manufactured by ALCO, under ALCO'S HIGH QUALITY CONTROL SYSTEM—to efficiently maintain *evaporator pressure* in either a single or multipal system—*regardless of load changes.*

*ALCO EPR VALVES are available from ½" to 6" port sizes and all connections up to and including 6⅛" O.D.F.— FOR ALL REFRIGERANTS.*

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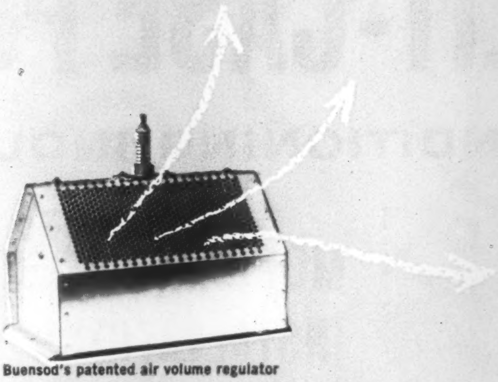
**The one complete line of refrigerant controls:** Thermostatic Expansion Valves • Refrigerant Distributors • Solenoid Valves Refrigerant Filter-Driers • Suction Line Regulators • Flooded Evaporator Controls and Reversing Valves



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**dual-duct with avc**

AVC . . . Automatic Volume Control . . . the patented, self-contained feature that sets Buensod Dual-Duct air mixing units head and shoulders above all others. Here's how it works: No matter what the variance in static pressures may be at either inlet or outlet valve, AVC maintains constant air volume ±5%. Therefore, the system cannot be thrown out of balance, regardless of daily changes in zone requirements. And remember, Buensod pioneered and developed Dual-Duct High Velocity Air Conditioning. Consider this advanced, year 'round method for your next installation . . . equally suitable in new or renovated structures. Send for Catalog DD-6.

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## FOR THE AIR CONDITIONING INDUSTRY

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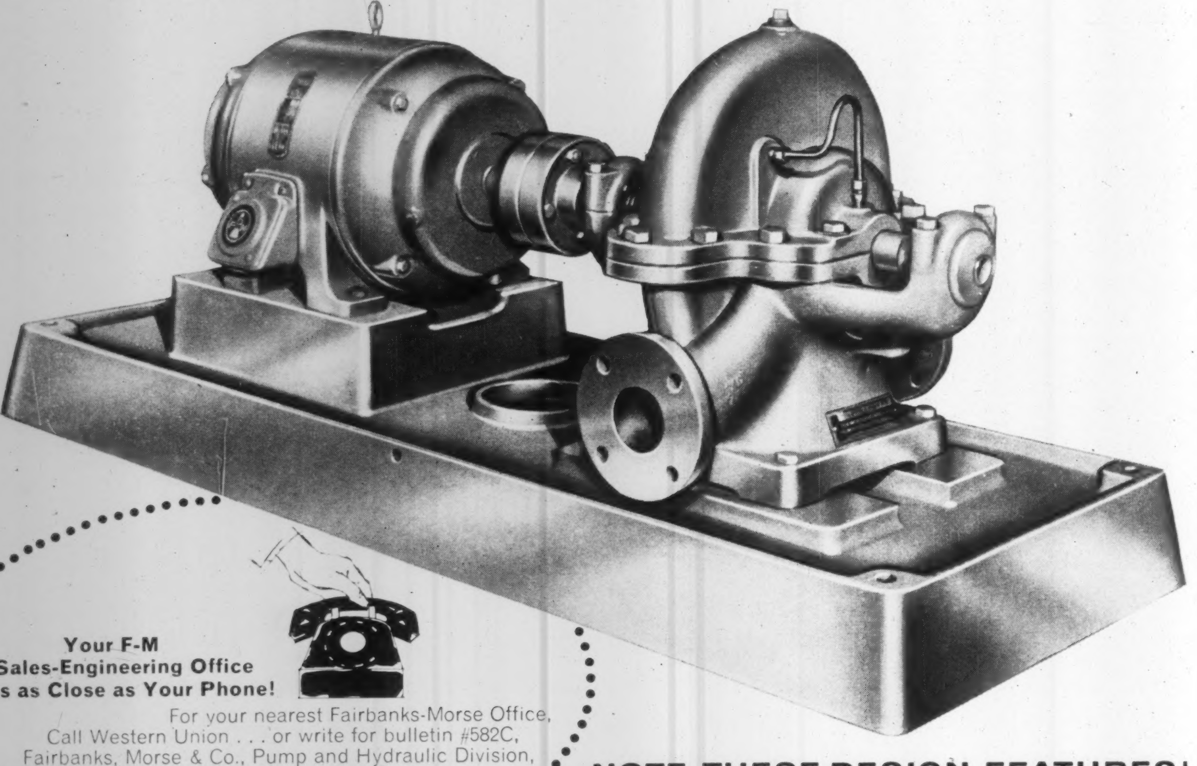
Single Stage, Horizontal Split-Case Centrifugal Pump for Chilled Water, Circulating or Booster Duty; Cooling Towers or General Water Supply.



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- Replaceable casing wearing rings . . . for increased pump service life
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- Heavy cast-iron base, drip-lip design

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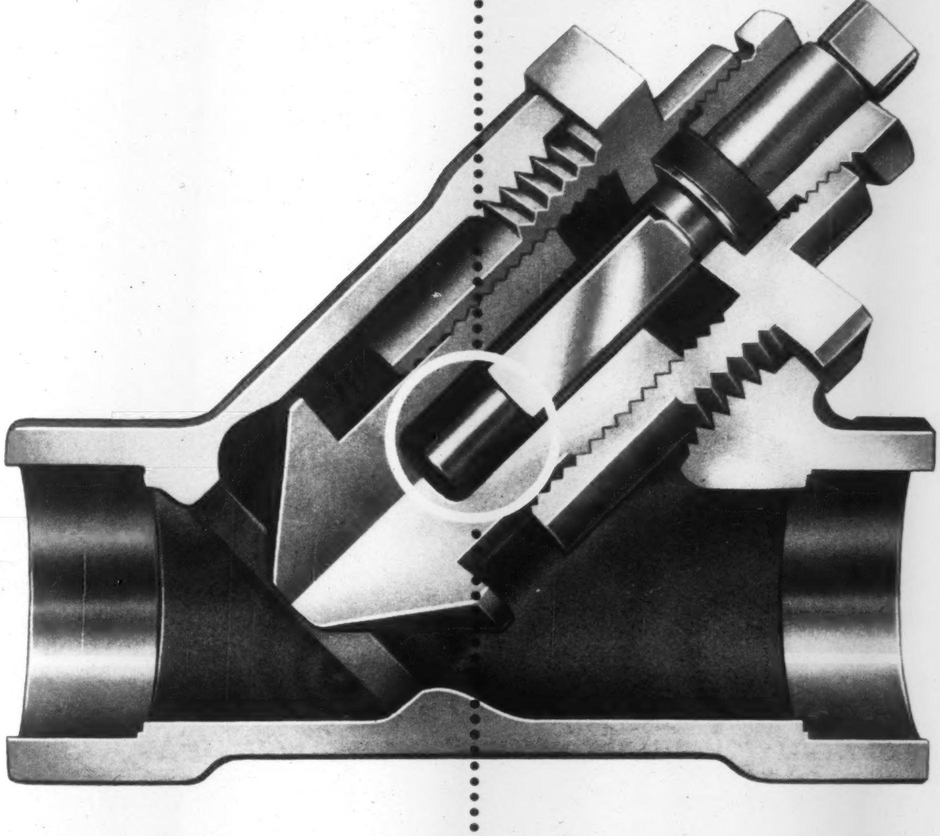

## Illinois "memory" device gives you one valve to do two different jobs!

A unique *internal "memory"* device in the new Illinois Water Balancing Valve gives you *one unit* that does the work of two *different valves.*

*It's a balancing valve:* Extremely accurate balancing is assured with 360 degrees stem rotation and a corresponding extension of the throttling range. Low pressure drop through the valve is achieved by internal streamlining and by having the bonnet mounted at a 45 degree angle to the piping.

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The Illinois Balancing Valve eliminates *one complete valve and fitting* in every unit, simplifies installation, and reduces system maintenance. It prepares your system for both accurate water flow regulation and absolutely tight shut-off.

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COMPANY, INC., LOUISVILLE, KENTUCKY

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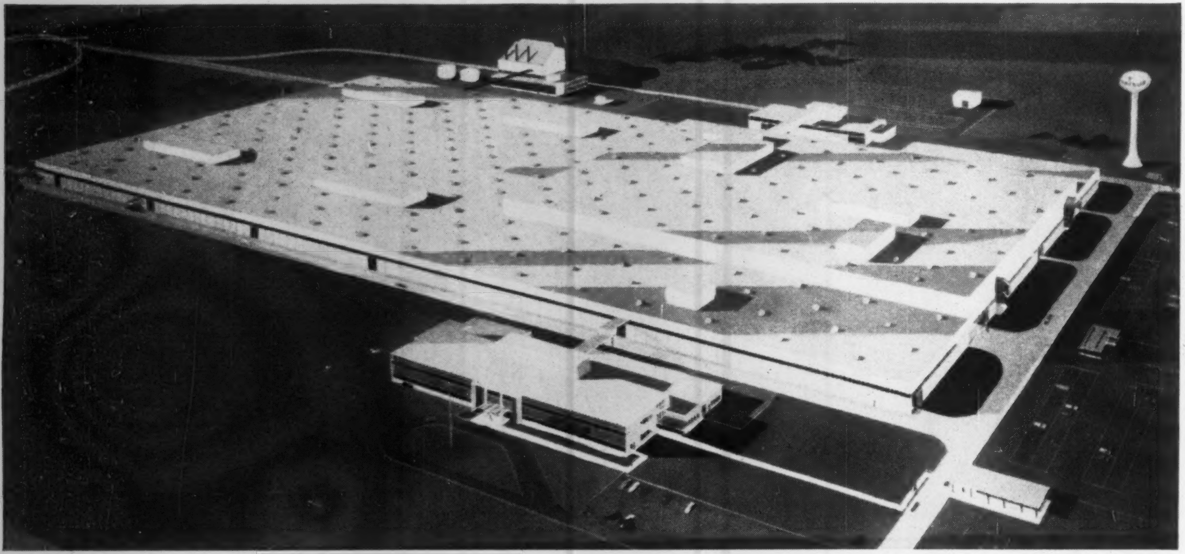
# NEW CHRYSLER CAR-A-MINUTE ASSEMBLY PLANT



ADMINISTRATION BLDG. — *Architects and Engineers:* SVERDRUP & PARCEL, St. Louis • *General Contractor:* FRUIN-COLNON CONTRACTING CO., St. Louis
ASSEMBLY BLDG. — ALBERT KAHN, *Associated Architects and Engineers,* Detroit • H. D. TOUSLEY CO., *General Contractor,* Kirkwood, Mo.

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That Jenkins Valves would minimize valve maintenance and replacement costs was assured by the service records of Jenkins Valves in other Chrysler Corporation plants.

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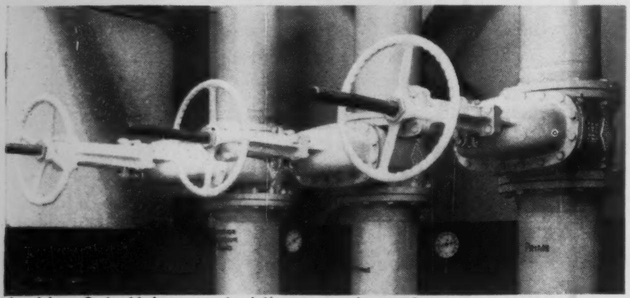
You can take the gamble out of valve costs with one word in your specifications or purchase order . . . the word for economy: "JENKINS." For information about specific valves, ask your local Jenkins Distributor or write—Jenkins Bros., 100 Park Ave., New York 17.



Jenkins Gate Valves control lines carrying paint as well as plumbing, heating, air conditioning.

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LOOK FOR THE JENKINS DIAMOND
**VALVES**
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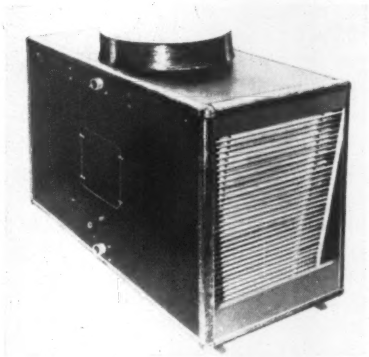
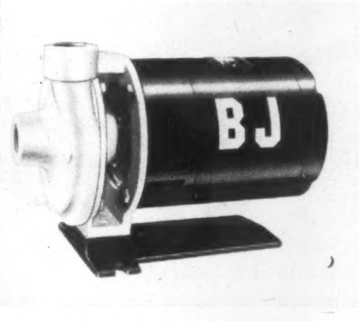
# EQUIPMENT DEVELOPMENTS

*Information on capacities, dimensions, applications, and special features in each item is presented in accordance with material furnished by the manufacturers, who may be contacted directly for more details. For reviews of Recent Trade Literature see page 241*



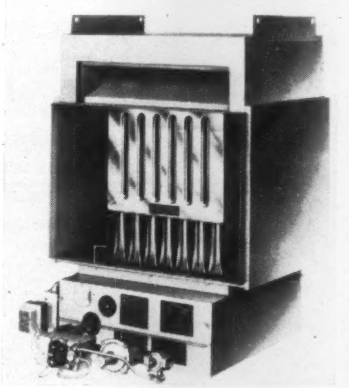
**Cooling Tower . . .**

. . . packaged unit with gravity flow water distribution system, automatic bleed-off arrangement, laminated wood panels with fiber-reinforced resin coating in casing and basin; all metal components are hot-dip galvanized; available in nominal sizes from 5 to 80 tons, shipped assembled requiring only piping and wiring connections; bulletin "PT-60" available upon request — *The Marley Co., 222 W. Gregory, Kansas City, Mo.*



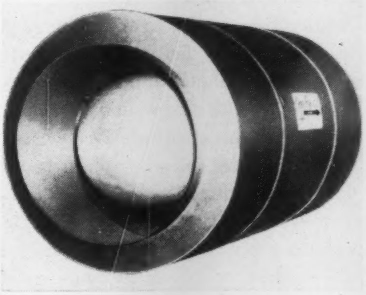
**Centrifugal Pump . . .**

. . . of close-coupled design for capacities up to 270 gpm, discharge heads to 150 ft, with 1/3 to 7-$\frac{1}{2}$ hp, single or three phase motors; features simplified mounting bracket to support both pump and motor in any position, utilizes single stainless steel shaft, mechanical seal; pump is single stage, with bronze impeller, integral suction and discharge connections; motors available in drip-proof, TEFC, and explosion proof types — *Byron Jackson Pumps, Inc., P.O. Box 701, Lawrenceburg, Ind.*



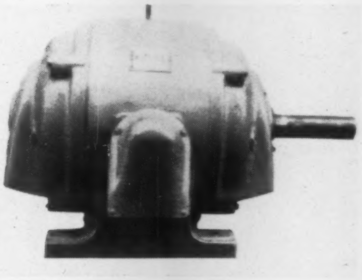
**Duct Furnace . . .**

. . . natural, mixed, or LP gas fired, with stainless steel burners, stainless or aluminized steel heat exchangers, offered in six sizes from 75,000 to 300,000 Btu per hr input, three height groups; feature built-in bypass eliminating need for extra duct, optional stainless steel drain pan for installation downstream of cooling surface in air conditioning systems; controls designed for 24 v service or conversion to 115 or 230 v with optional transformer; bulletin "659-B" available upon request — *Modine Mfg. Co., 1509 De Koven Ave., Racine, Wis.*



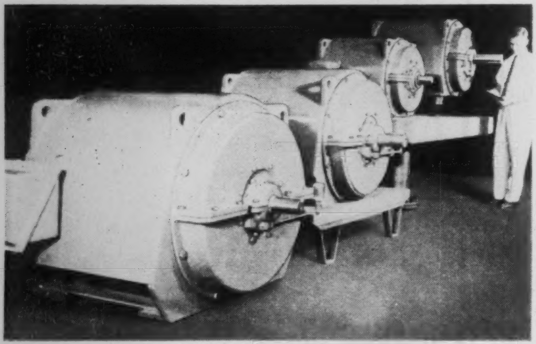
**Silencer Unit . . .**

. . . for high pressure round duct air systems uses new airflow configuration with bell-mouth entrance for minimum pressure loss, solid cone for maximum noise reflection; literature available upon request — *Industrial Acoustics Co., Inc., Air Conditioning Dept., 341 Jackson Ave., New York 54, N.Y.*



**Electric Motors . . .**

. . . with multi-shielded protection, in 20 to 40 hp models, are shielded five ways against environmental hazards, including splash resistant enclosure, bearing cap, labyrinth seal on output shaft, double shielded ball bearings and high dielectric winding insulation — *Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles 22, Calif.*

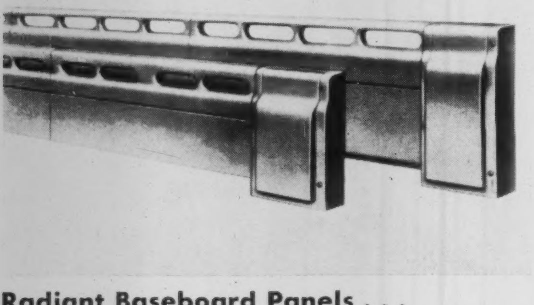


**Electric Motors . . .**

. . .squirrel cage type, 250 through 1000 hp for heavy duty applications feature fabricated steel plate enclosures for strength and corrosion resistance, lifting eyes integral with frame ends; enclosure is drip proof with ventilation openings located to provide splash-proof protection, winding fabricated of pre-formed copper strip coils with brazed ends; stator and rotor core are designed to permit radial and transverse air circulation; available in 440, 550, 2300, and 4160 v, 60 cycle, various speed ranges—*Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14, Mo.*

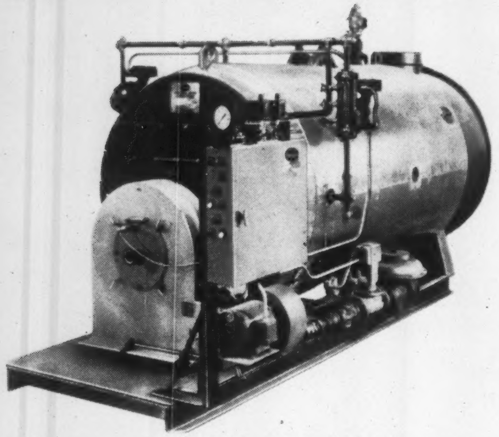
**Axial Flow Fans . . .**

. . .in complete line of sizes from 1000 to over 500,000 cfm, pressures from atmospheric to 10 in. WG for single stage units, models up to 12 in. diam in fixed blade design, 14 to 120 in. diam in "blade retention" designs; available drives include belt, coupling, or direct—*Benson Mfg. Co., Commercial Blower Div., Kansas City 27, Mo.*



**Radiant Baseboard Panels . . .**

. . .for hydronic installations available in 8 and 10 in. high models, 12 and 24 in. lengths; of cast iron construction, can be installed against wall or recessed to depth of plaster; with full line of matching accessories which can be removed without damage to walls—*American Standard Plumbing and Heating Div., 40 W. 40th St., New York 18, N.Y.*

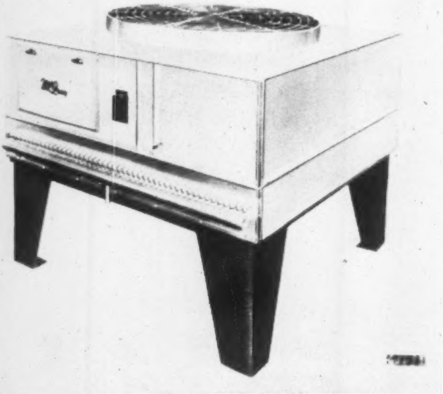


**Packaged Boiler . . .**

. . .Scotch-type automatic 3-pass design for 80, 125, 150, and 200 hp operation at 125 psi; natural, LP, or mixed gas fired models plus oil fired or combination gas and oil units available; forced draft combustion design requires only short stack for flue venting; shipped ready for connection to power, steam, water, and fuel lines, with boiler and burner safety and operating controls included; bulletin "A-104-3" available upon request—*Eclipse Fuel Engineering Co., Boiler Div., Chattanooga, Tenn.*

**Power Roof Ventilators . . .**

. . .with capacities from 2720 up to 27,290 cfm, in four sizes, ½ to 12 hp; feature new airfoil design, venturi-type inlet, weather tight housing, direct connected drive, permanently lubricated motor, "low roof" silhouette; bulletin "2701-S" available upon request—*Ilg Electric Ventilating Co., 2850 N. Pulaski Rd., Chicago 41, Ill.*



**Air Cooled Condensers . . .**

. . .for 8 to 85 ton applications, in 13 sizes with horizontal or vertical air flow; constructed of galvanized steel, with automatic head pressure controls optional; specifications and information available upon request—*McQuay, Inc., 1600 Broadway N.E., Minneapolis 13, Minn.*

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"U. S." Expansion Joints of
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Typical of these are:

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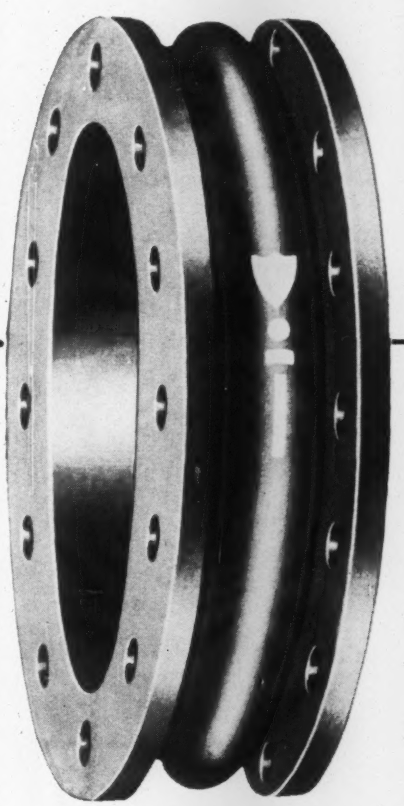

"U.S." Expansion Joints remain completely flexible at all times. Joints made of neoprene or natural rubber stiffen up, crack and fail when handling the above chemicals.

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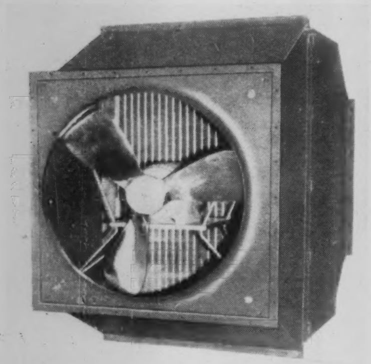
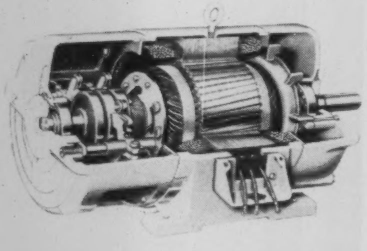


## Make-up Air Heaters . . .

. . .consist of single cabinet housing steam coil and propeller fan; in four sizes with capacity ranges from 4000 to 36,000 cfm, 380,000 to 2,642,000 Btu per hr at 5 psi steam pressure; available with or without filters and distribution ducts, or minus coil for ventilation only; also belt drive fans, vaneaxial and centrifugal blowers for external mounting available on special order; separate control package includes modulating thermostat and steam valve plus pressure device to protect against freeze-up — *Hartzell Propeller Fan Co., Piqua, O.*

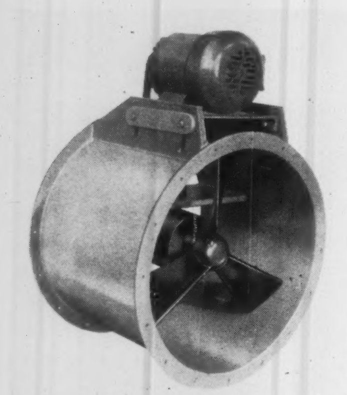


## Electric Motors . . .

. . .of wound rotor design in NEMA frame sizes 213 to 326 U, feature reduced size and weight, cast iron housings, oversize grease reservoirs; rotor ends are hydraulically balanced, end coils banded with epoxy glass fiber to eliminate end coil shorts; can be furnished with open, drip proof, or sealed non-ventilated enclosures for horizontal, ceiling, or sidewall mounting — *The Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.*

## Tank Drainer . . .

. . .for fast draining and air charging of expansion tanks serves as system shutoff valve, air fill valve, and hose drain-off connection beside tank drain; operation is by "dual seat" principle: as flow to tank is stopped, drain valve is simultaneously opened; closing of drain automatically opens intake line — *Watts Regulator Co., 10 Embankment St., Lawrence, Mass.*

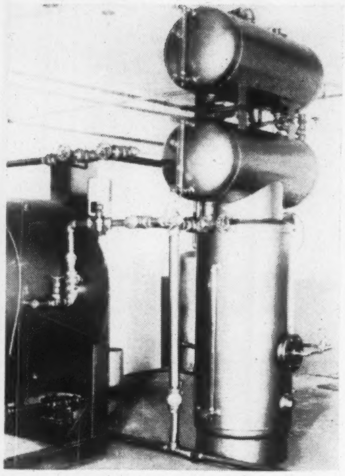


## Tubeaxial Fans . . .

. . .for corrosive air handling applications are available in 16 to 36 in. diam sizes, with capacities to 25,000 cfm; of vinyl construction, fans are belt driven with propellers of polyvinyl chloride or stainless steel; bearing assembly incorporates stainless steel shaft, units are also available with sheet or sprayed plastic coated steel drums — *Propellair Div., Robbins & Myers, Inc., Springfield, O.*

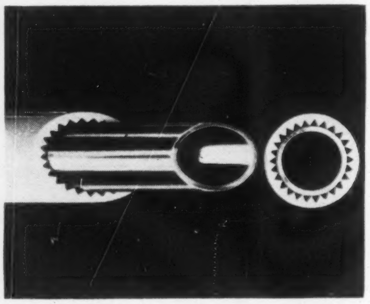
## Valve, Damper Operator

. . .pneumatic, to position valves, dampers, other control devices on heating and processing equipment develops 400 ft lb operating torque and 800 ft lb stall torque with 45 psi air supply, can be pneumatically or electrically controlled; other models handle lower and higher ranges; drive lever rotation is 75 deg, lever can be mounted at either end of output shaft at 10 deg increments; linear, square, and blank cams are supplied with unit, variety of optional accessories available — *Republic Flow Meters Co., 2240 Diversey Pkwy., Chicago 47, Ill.*



## Boiler Feed System . . .

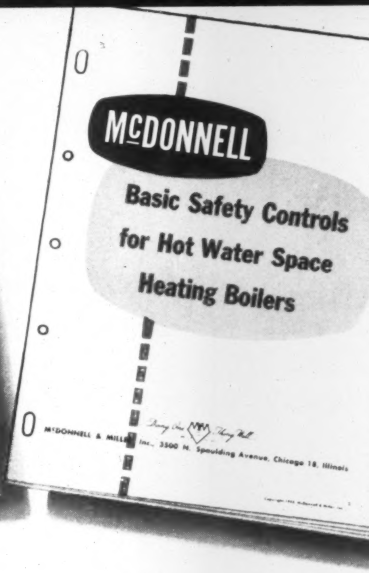
. . .consists of three-tank complex which provides collection of condensate return and make-up water, deaeration, preheating by means of boiler steam, and gravity feed through normal boiler water regulator device; operates by alternately producing vacuum and pressure in upper tank causing flow *from* collection point in lower tank and *to* middle tank where steam is admitted to maintain feed at near-boiler pressures, eliminating flash losses upon introduction to boiler; adaptable to all natural circulation firetube and watertube boilers, or with modification for forced-circulation units — *H T Boiler Feeder Co., P.O. Box 362, Phoenixville, Pa.*



## Copper Tubing . . .

. . .with polyvinylchloride thermal insulation factory extruded over tube; suitable for use in temperatures up to 212 F, inner surface of insulation is serrated so that longitudinal air chanels are formed between tubing and jacket — *Columbia Technical Corp., 61-02 Thirty-first Ave., Woodside 77, N.Y.*

McDONNELL
Basic Safety Controls for Low Pressure Steam Boilers
McDONNELL & MILLER, Inc., 3500 N. Spaulding Avenue, Chicago 18, Illinois


McDONNELL
Basic Safety Controls for Hot Water Space Heating Boilers
McDONNELL & MILLER, Inc., 3500 N. Spaulding Avenue, Chicago 18, Illinois

McDONNELL Flow Switches
McDONNELL & MILLER, Inc., 3500 N. Spaulding Avenue, Chicago 18, Illinois

**McDonnell Flow Switches**—Points out the almost endless uses of flow switches for safety control and automatic control. Covers details of construction, service ranges, applications.

**Basic Safety Controls for Low Pressure Steam Boilers**—Answers all safety control problems that arise in low pressure steam field. The full story of correct hook-up and proper wiring in simple statements and clear diagrams.

**Basic Safety Controls for Hot Water Space Heating Boilers**—Companion piece to "steam" book opposite. Correct solution of all safety control problems in the area of hot water space heating boilers.

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☐ Hot Water Companion Booklet, P-30-C
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**City, Zone, State**________________

**By**________________

**Mail to: McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, Ill.**

# 15 miles of SPANGrid Steel Pipe help provide five-month skating season at Columbus, Indiana

Fifteen miles of SPANGrid Steel Pipe and 49,632 Spang Couplings form the grid for the Lincoln Center Ice Rink at Columbus, Indiana. One of the largest rinks in the country, it measures 225′ x 85′, and can be used as one large rink or divided into two separate operations.

Mr. Virgil W. Taylor, partner in Taylor Brothers Construction Company, installers of the piping, says, "We used 1¼″ SPANGrid Steel Pipe on 3½″ centers. We installed double random lengths which reduced job time since about half the usual number of couplings were required.

"SpanGrid is easy to work with. It's straight and uniform, bends easily, and there are no imperfections, there's probably no pipe better than Spang; we know, because we've used it on other projects in the past."

During the first year of operation, pipes remained exposed under the ice to allow the ground to settle and to be sure all "bugs" were worked out. At the end of the season, pipes were buried in one continuous slab of concrete. Now the rink area is used in warm weather for badminton, volleyball, dancing and roller skating.

### THERE'S MONEY FOR YOU IN ICE RINK CONSTRUCTION

More and more municipalities and schools are planning ice rinks, both indoor and outdoor. You can cash in on this trend by helping promote rink construction in your area.

And when it comes to the piping, you can't install anything better than SPANGrid Steel Pipe . . . especially manufactured to provide years of top-quality service in ice rink, snow melting and radiant heating systems. For technical help, call on Spang. For top-quality service on "Made in U.S.A." SPANGrid Steel Pipe, call your nearby Spang Distributor.

Steel

Steel's Symbol of strength, long life and economy

Piping Contractor: Taylor Brothers Construction Company, Columbus, Ind.

Engineering Design: Charles R. Beltz, Detroit, Mich.

SPANG Distributor: The Nelson Company, Detroit, Mich.

SPANG CW STEEL PIPE

**THE NATIONAL SUPPLY COMPANY**

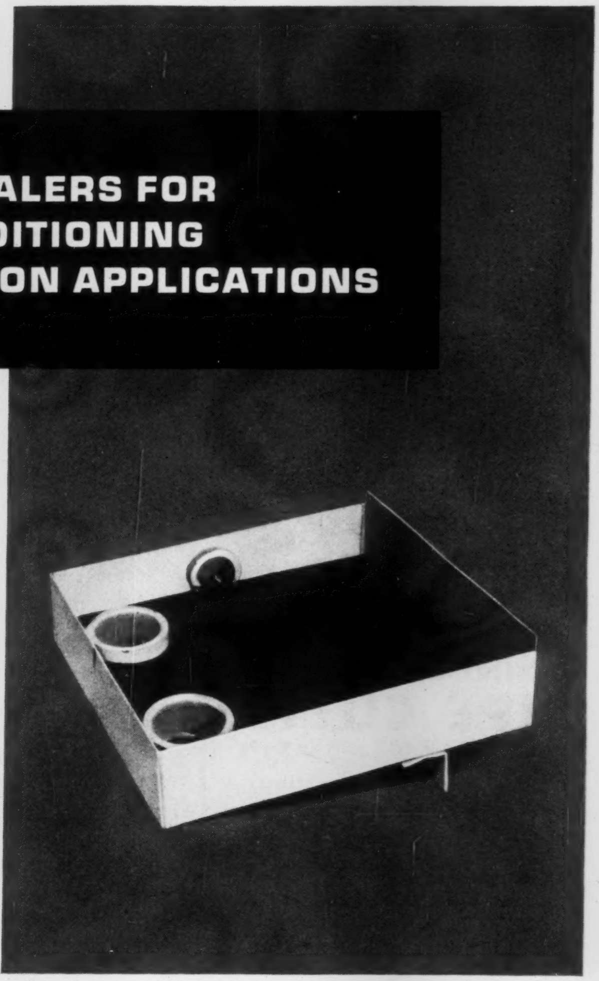
Two Gateway Center, Pittsburgh 22, Pennsylvania

Subsidiary of Armco Steel Corporation

ARMCO®

# WITCO SEALERS FOR AIR-CONDITIONING AND REFRIGERATION APPLICATIONS

CAREFUL TESTING of all Witco products means uniformity and high quality for you. Here, a lab technician checks a sealer with a penetrometer. This and many other tests check every characteristic that is vital to performance. Every sealer shipped must meet Witco's high standards and perform faultlessly for you.



WITCO'S ASPHALTIC SEALERS and vapor barriers are specially designed for air-conditioning and refrigerating applications. Good flexibility and excellent adhesion are exhibited over a wide temperature range (from below freezing to abnormally hot temperatures). Formulations to meet special application requirements are manufactured to customer order.

## WITCO PRODUCTS ASSURE TOP QUALITY AND PERFORMANCE

Providing products especially suited to particular jobs is just one way Witco assures top performance. Take Witco's Plastic Sealer 320, for example. This material is an all-purpose sealer used where hard, dry films are required. It is stainless, tasteless, odorless and forms air-tight, positive seals.

Pioneer E 14442 is a hot-applied sealer with odor level and moisture resistance that make it ideal for refrigerators, freezers, food-vending machines and water coolers. Pioneer E 2205 also can be used in these applications. It is a high-melting-point sealer and retains high cold flow and flexibility at low freezing temperatures; it also assures good adhesion and excellent sealability.

The big reasons behind Witco Products' superiority are research and quality control. Every Witco Product is produced under the kind of strict laboratory quality control that assures uniformly high performance from shipment to shipment, year to year.

Witco's research laboratories and technicians not only develop new and improved products, but are available to help you with special problems. Write or call the nearest Witco sales office listed below for further information about these products and for information on sealers for other specialty applications.

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PIONEER PRODUCTS DIVISION
Dept. 81-02, 122 East 42nd Street, New York 17, N. Y.
Sales Offices: New York • Chicago • Akron • Los Angeles • Toronto and Montreal, Canada

Cut Steel or Cast Iron Pipe up to 12″
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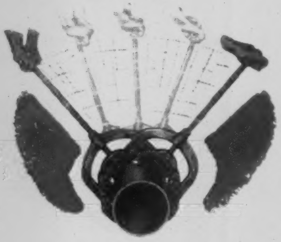
WITH THE NEW REED



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PIPE CUTTER

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- 4-Point pipe guide aligns cutter for perfect tracking of wheels and a right angle cut.
- Quickly interchangeable wheels for steel or cast iron.
- Needs only 3″ space to pass under 12″ pipe.

*For ditch work or similar close-quarter operations these new Reed Cutters are practically indispensable and fully justify replacing whatever cutting equipment you are now using.*

*You can, for example, cut 8″ steel pipe in less than five minutes, and cast iron pipe even faster.*

*Available in five sizes for steel or cast iron pipe from 1″ to 12″.*

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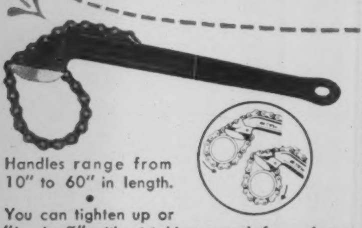

Handles range from 10″ to 60″ in length.

You can tighten up or "back off" without taking wrench from pipe.

*These improved chain wrenches will do anything an ordinary pipe wrench will do . . . and do it easier, better and faster. Ideal for ditches or tight corners.*

*Grip securely with no play, yet they have a ratchet-like action.*

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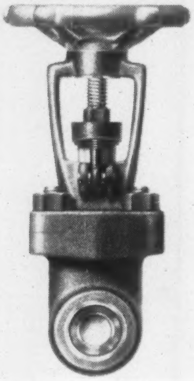
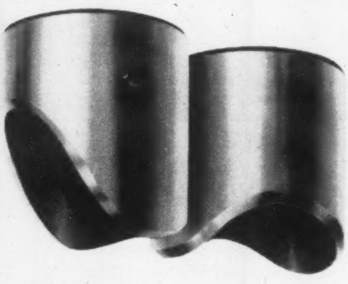
## EQUIPMENT DEVELOPMENTS

*Continued*



**Gate Valves . . .**

. . .of forged steel in ¼ to 2 in. size range feature malleable iron wheels, "Exelloy" stems, two piece ball type packing gland, stainless steel eyebolts hinged to bonnet for easy access, spiral wound stainless steel bonnet joint gasket with asbestos filler; choice of trim includes "Exelloy" disc and stellite faced seat rings for oil service temperatures to 1000 F, steam temperatures to 850 F, plus Class L trim for liquid and gas temperatures to 750 F — *Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.*



**Welding Fittings . . .**

. . .saddle type, in 45 and 90 deg angles, three weight schedules: A-53, A-106B and A-106 with mill test certificate upon request; sizes range from 1 through 12 in. for welding and 1 through 4 in. for threaded filling, all are beveled for welding; special fittings 1 through 36 in. in aluminum, alloy, or stainless steel are also available in any desired angle — *Allied Piping Products Co., Inc., Fittings Div., P.O. Box 311, Salem, O.*

*Owens-Illinois Paper Products Division Plant, Chicago*

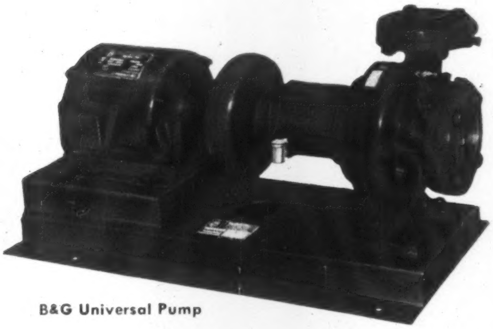
**Architects-Engineers:** Skidmore, Owings and Merrill, Chicago, Illinois
**Associates:** Owens-Illinois Engineering Department
**General Contractor:** G. C. Luria Engineering Company
**Heating Contractor:** National Heat and Power Company, Chicago, Illinois

# AUTOMATED CONTAINER PLANT HEATED BY B&G *Hydro-Flo*® FORCED HOT WATER SYSTEM

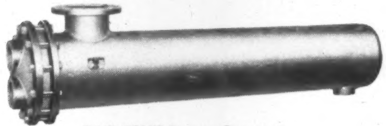
The high manufacturing efficiency of this 225,000 sq. ft. automated plant is matched by the efficiency of its heating system. Both office and factory workers are kept comfortable by a forced hot water system using B&G pumping and other *Hydro-Flo* equipment.

The selection of B&G Booster and Universal Pumps was dictated by the record of these units for quiet, vibrationless and dependable operation. They are not ordinary commercial centrifugal pumps, but are specifically designed and built to meet the exacting requirements of circulated water systems. Over 3,000,000 are operating today in heating and cooling systems.

Other B&G products installed in this outstanding building include "SU" steam-to-water converters, an Airtrol System for the positive elimination of air from the system and expansion tanks.



**B&G Universal Pump**



**B&G "SU" Steam Converter**

**B&G Booster Pump**

**BELL & GOSSETT COMPANY**

**Dept. GI-5, Morton Grove, Illinois**

*Canadian Licensee: S.A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario*

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How to Stabilize Air-Supported Structures

EVEN IN 70 MPH WINDS, PEERLESS ELECTRIC BLOWERS FIRMLY SUPPORT THESE HUGE ARMY PENTADOMES

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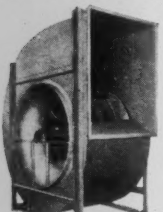
Peerless Electric has pioneered the application of inflating and maintaining a variety of air-supported structures, including Radomes. The same skills that engineer air for Pentadomes can go to work for you. Write to *Peerless Electric Division, H. K. Porter Company, Inc., West Market Street, Warren, Ohio.*



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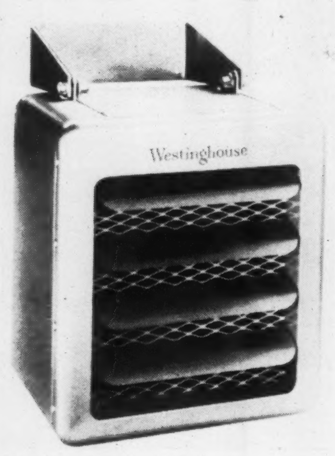
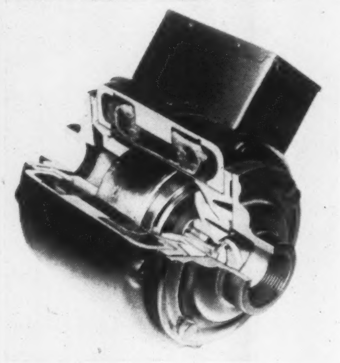
## EQUIPMENT DEVELOPMENTS

*Continued*



**Electric Heaters . . .**

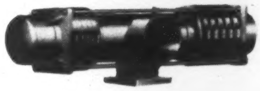
. . . available in size range of $1\frac{1}{2}$ to 36 kw with manual or automatic control; two styles covering above range provide up to 25,590 Btu per hr at 380 cfm and 122,000 Btu per hr at 2560 cfm; with direct drive fans, spiral design steel sheathed heating element, aluminum fan wheels, plus built in thermal limit and adjustable louvers — *Westinghouse Electric Corp., Air Conditioning Div., Staunton, Va.*



**In-Line Pump . . .**

. . . for low head, high volume discharge service, with 1/6 to $\frac{3}{4}$ hp motor, of stainless steel, alloy, bronze, cast iron, or monel construction, may be supported in any position, has one moving part, rotor-impeller driven by stator currents from center of motor; front and rear bearings are lubricated by liquid being pumped — *The Corley Co., Inc., Boonton, N.J.*

it's Adsco or the gaspipe!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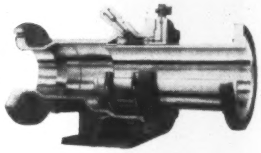
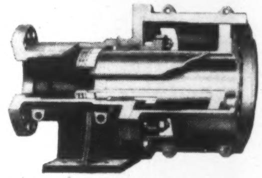

RAM-PAK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ONLY ADSCO HAS ALL 3 TYPES OF EXPANSION JOINTS

Choose Adsco, by all means. An Adsco man is no farther away than your telephone. He's a calm, cool and collected fellow who can straighten out any piping problem. He loves to be asked . . . call him quick, man, before it's too late!

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WEINMAN

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**EFFICIENT... DEPENDABLE**

Weinman Types ACV and ADV Condensate Return Units are a wise investment in fast, trouble-free condensate return and overhead return of water or other liquids in gravity circulating systems.

**SINGLE AND DUPLEX PUMP MODELS**

Weinman designs single pump models to meet standard requirements; duplex pump units for systems with heavy condensate loads and other liquid return or where a standby pump is needed. Both types handle liquids to 200° F. under hard, continuous service.

**STEEL OR CAST IRON RECEIVERS**

Both units are available with either steel or cast iron receivers to meet specific requirements for handling different liquids.

**BOILER FEED UNITS**

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Weinman Condensate Return Units are rated up to 65,000 sq. ft. EDR at 60 psi. For complete information write for Bulletins 900 and 910 or call your Weinman pump specialist. He's in the Yellow Pages.

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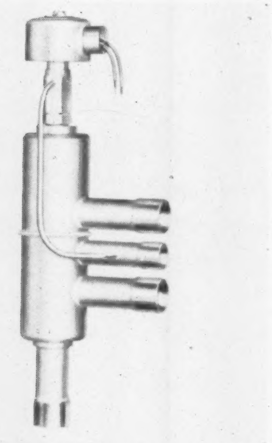
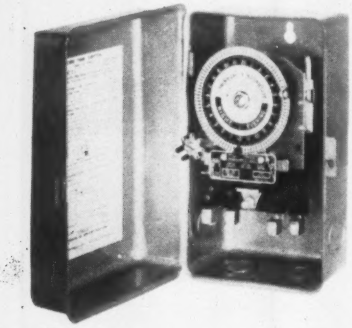
## EQUIPMENT DEVELOPMENTS

*Continued*



**Reversing Valve . . .**

. . . for heat pump applications features hermetically sealed construction, is actuated by 3-way solenoid operated pilot valve; with synthetic seats to reduce wear, valve is supplied in standard voltages, has maximum operating pressure differential of 300 psi at 85 percent of rated voltage; in three sizes for refrigerants 12, 22, and 500, bulletin "100-10" available upon request — *Sporlan Valve Co., 7525 Sussex Ave., St. Louis 17, Mo.*



**Time Control . . .**

. . . for high pressure steam systems, opens motorized valves at one pulse per minute rate to reduce wear on valve parts, eliminate radiator knocks; consists of double pole double throw switch with controls available to permit omission of operation on one or more days each week without altering master program — *Tork Time Controls, Inc., Heating Controls Div., Mount Vernon, N.Y.*

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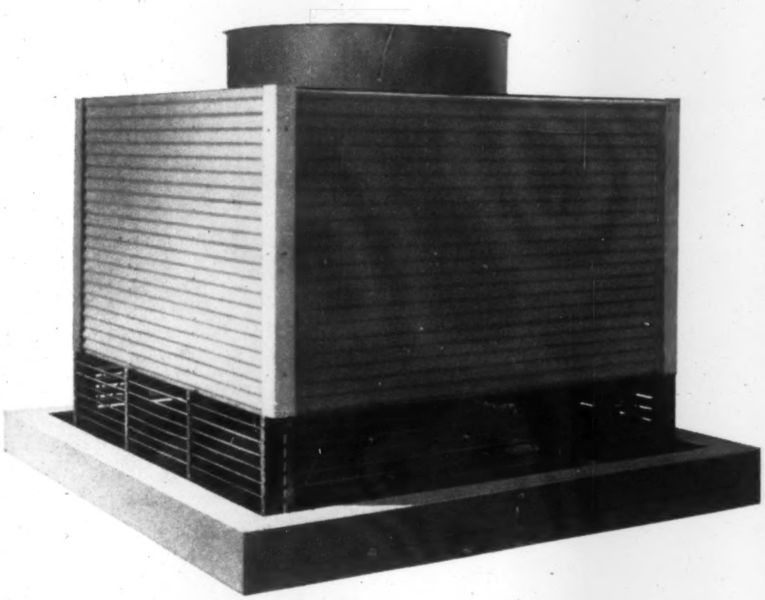

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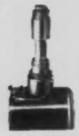
**K-1** 1/4" & 3/8" Light-Duty Captive Stud Attachment uses 22 cal. Power Loads. Use where extra safety is needed.



**K-2** 1/4" Light-Duty Attachment uses 22 cal. Power Loads. Handles 80% of your fastening jobs.

**K-3** 3/8" Medium-Duty Attachment drives heavy-duty studs with inexpensive 22 cal. Power Loads.

**K-4** 3/8" Medium and Heavy-Duty Attachment. Uses both 22 and 32 cal. Power Loads. For toughest jobs.

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The Remington Stud Driver offers these exclusive features:

- Four fastening attachments for light, medium, heavy-duty work, including the special Captive Stud Attachment for extra-safe fastening. No other single tool can cover such a variety of applications.
- Medium-duty fastening—requiring ⅜" studs—can be done with low-cost 22 caliber Power Loads.
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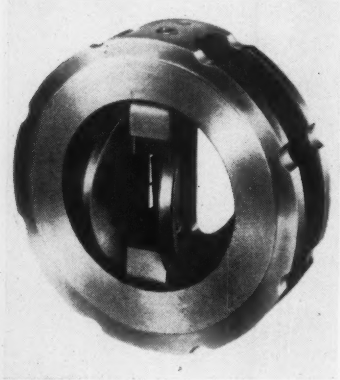

**Check Valve . . .**

. . . fits between pipe flanges and is centered by flange bolts, features "duo-check" action and anti-slam spring closure for positive seating without slamming, easy opening with very little pressure on upstream side; resilient sealing material is molded into plate groove, is deformed by pressure for metal-to-metal contact between plate and body seat; teflon or metal seals also available; available in sizes through 36 in., for ASA pressure ratings of 150 through 2500 psi in steel, stainless steel, aluminum, and aluminum bronze — *Mission Valve and Pump Co., P.O. Box 4209, Houston, Tex.*

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HOURS

**Time Totalizer . . .**

. . . registers up to 9,999.9 hours total operating or non-operating time for any electrically controlled equipment, weighs 4 oz, operates on 115 v 60 cycle or 400 cycle power; drum type counter is driven by constant speed motor, housings available for front or back panel mounting — *Cramer Controls Corp., Centerbrook, Conn.*

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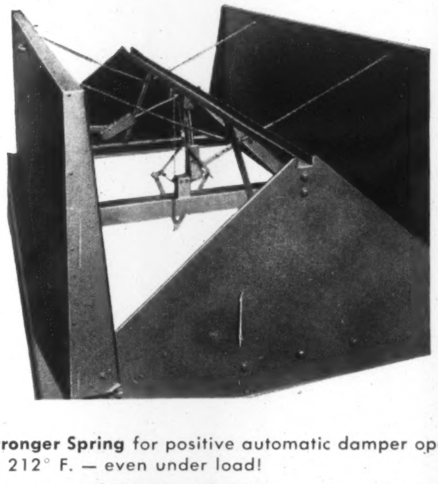

- **Stronger Spring** for positive automatic damper opening at 212° F. — even under load!
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With Swartwout Pyrojectors you get positive fire and explosion control worth many times the small investment involved. Favored by insurance authorities, automatic release of heat, smoke or explosive blasts holds plant damage to a minimum.

Double-walled, thickly insulated and weather-tight dampers fly open when underwriters-approved fusible link melts at 212° F. Snubber springs and chains hold dampers vertical for maximum draft. Pyrojectors provide 28 square feet of free escape area.

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## EQUIPMENT DEVELOPMENTS

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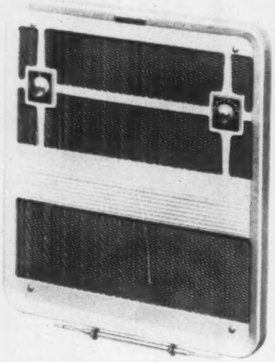

**Electric Heaters . . .**

. . . available in 2000 to 4800 w models for 240 or 208 v operation, for recessed wall mounting or surface mounting on masonry walls; feature 8 in. diam. 700 rpm fans, enamel finish, aluminum louvers, equipped with automatic reset safety switch to prevent overheating when airflow is obstructed, automatic thermostat control and separate on-off switch, plus access door for servicing of main feeder line — *Markel Electric Products, Inc., Buffalo 3, N.Y.*

**Foil Insulation . . .**

. . . designed for use in shops above permanent ceiling can be applied direct without extra supports, consists of aluminum foil layers to reflect radiant heat and block heat by convection, with reflective air spaces for minimum conduction, with vapor proof backing; can be stapled directly to wood construction or to wood furring strips in metal construction — *Reflectal Corp., 200 S. Michigan Ave., Chicago 4, Ill.*

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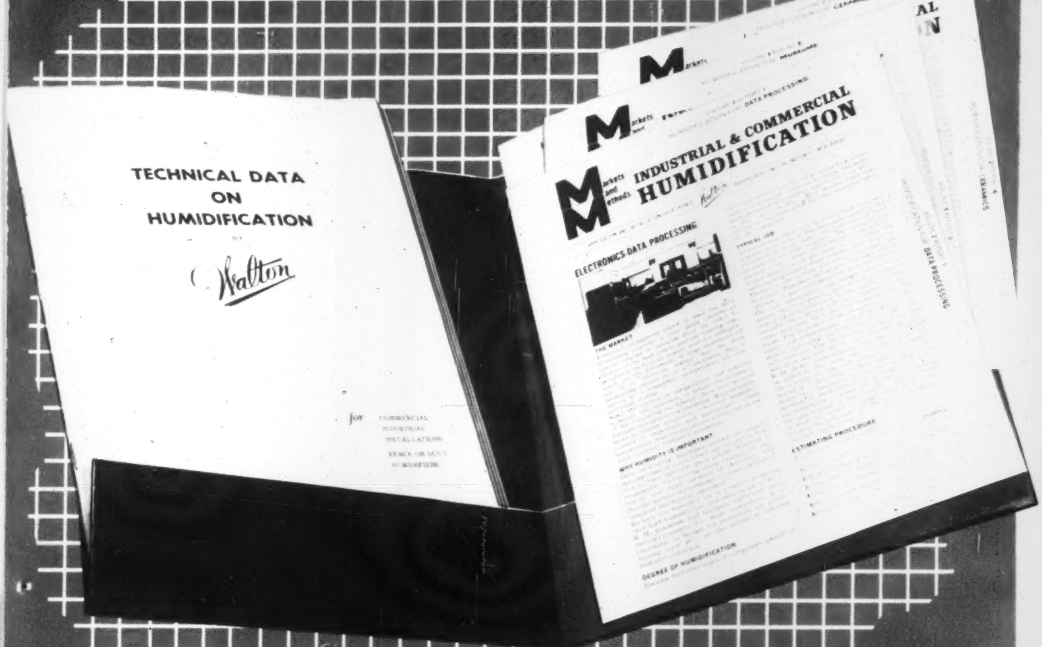
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## when we contract to install our air conditioning or refrigeration systems

WHEN FRICK designs, manufactures and installs an air conditioning or refrigeration system of *any* size . . . *it works.* We guarantee that by written contract; no excuses, no alibis, no putting the blame on any component manufacturer.

Because of our complete and unique engineering service, the pride we take in our work and our 107 years of experience, we have . . . with the cooperation of architects, consultants, and contractors . . . designed, installed and *guaranteed* air conditioning and refrigeration systems of all types . . . for hotels, restaurants, stores, office buildings, hospitals, processing and industrial plants.

Write for estimates. Better yet, a FRICK engineer will be happy to discuss your problem with you. No obligation.

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**Waynesboro, Pennsylvania**

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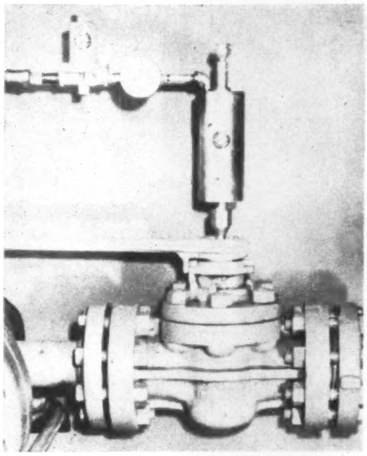
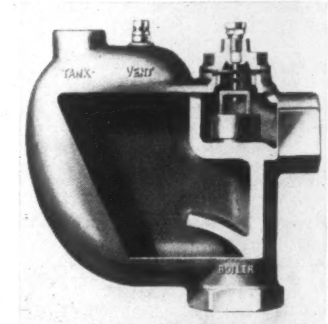
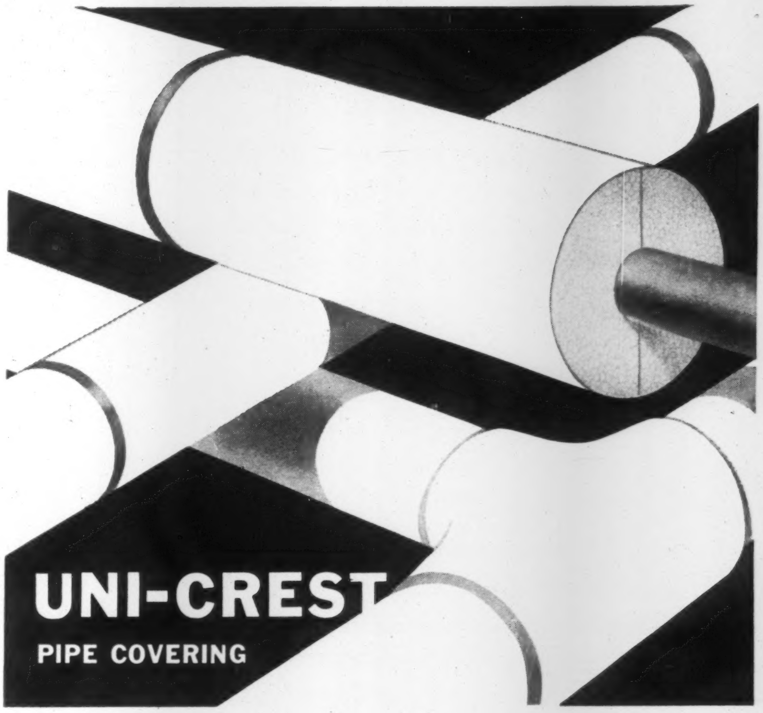


**Valve Lubricator . . .**
. . . designed for use in conjunction with firm's line of plug valves provides continuous and regulated supply of lubricant which acts as seal when valve is closed, provides hydraulic jacking action for easy turning of long disused valves, reduces wear and friction; includes built-in indicator, remote control limit switch; operates on air or gas at up to 250 psi inlet pressure, intended for valves not over 6 in. in size — *Rockwell Mfg. Co., Meter and Valve Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.*



**Venting, Drain Unit . . .**
. . . for hot water space heating systems includes air eliminator, flow check, and automatic air vent in one-piece casting, plus available tapping for expansion tank line; internal construction directs air to surface for fast removal, flow check prevents gravity flow during summer operation; can be installed directly on riser — *Watts Regulator Co., 10 Embankment St., Lawrence, Mass.*



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PIPE COVERING

a new, economical, low temperature insulation

Uni-Crest expanded polystyrene pipe covering is an excellent low temperature insulating material, and is inexpensive to install and maintain.

Its low thermal conductivity (K factor) plus its high resistance to water and water vapor — are some of its prime qualities. It will not rot, mildew, or support fungus growth.

Extremely lightweight, with a smooth, tough white surface, Uni-Crest is non-dusting, non-flaking, and easily cut and handled on the job.

Uni-Crest and self-extinguishing Uni-Crest are available in a wide variety of sizes and shapes. Both types are also available with or without a paper and foil laminate jacket.

*For the address of the office nearest you, plus additional information and an actual sample, please write to the address below.*

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Since 1907

UNITED'S UNI-CREST EXPANDED POLYSTYRENE

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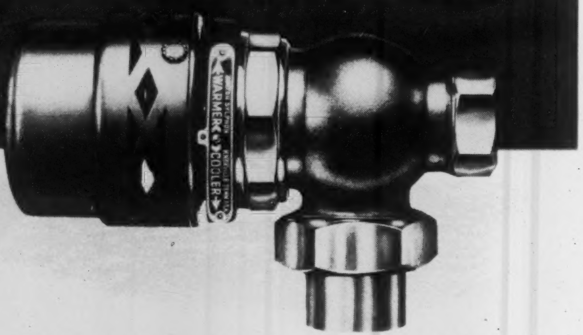
BRANCH OFFICES OR APPROVED DISTRIBUTORS IN ALL KEY CITIES

**Lowest Cost *Individualized* Control**

**. . . for one office or a 400-room hotel!**

**ROBERTSHAW AUTOMATIC RADIATOR VALVES**



**No. 885 for exposed radiators**

The most flexible, lowest-cost answer yet to the need for *individualized* control of new or existing heating plants!

Replace ordinary radiator valves with these Robertshaw Automatics . . . design them into your largest, most modern new installation . . . and you have perfect control combined with outstanding economy.

Actuated by sensitive Robertshaw seamless metal bellows, these precision valves are easily adjusted to individual needs . . . and can be locked to retain their setting.

- For steam or hot water service
- Positive response to temperature changes
- Self-contained, self-operated
- No packing to wear out
- Low initial cost; no upkeep

Complete Specifications in Catalog LH-B, **Fulton Sylphon Division, Robertshaw-Fulton Controls Company, Knoxville 1, Tenn.**

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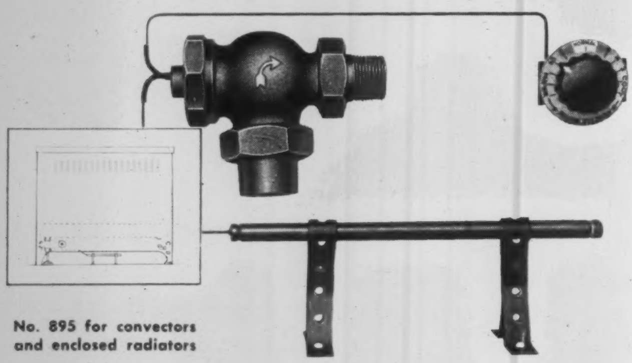
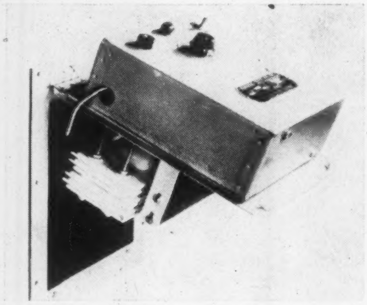
MR CONTROLS

**Robertshaw-Fulton Controls Co.**



**No. 895 for convectors and enclosed radiators**



**Ion Generator . . .**

. . . uses ultra-violet rays to produce negatively ionized air which oxidizes to destroy odor, smoke, bacteria impurities in circulation through warm and cold air ducts; non-metallic generator installs in duct, produces ultra violet rays without sparks, direct arc, or heat; generator is kept dry by integral humidity control device; available in units to handle air flow from 300 to 3000 cfm, other units offered in variety of types and sizes for free-standing or portable applications in varying-sized enclosures — *Vita-Aire Process Co., Inc., Milwaukee, Wis.*

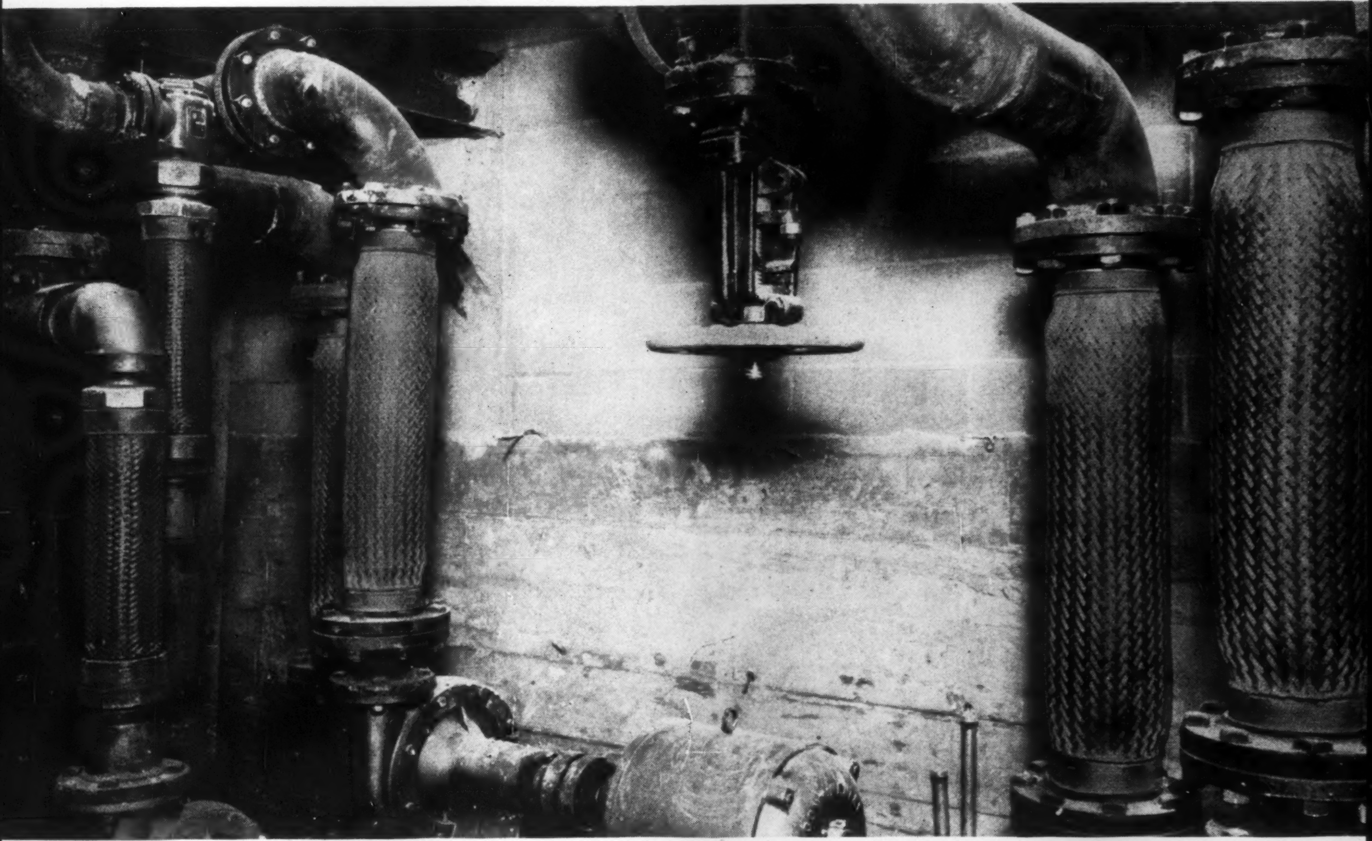
NO. 8 THRUSH
WATER
FLOAT AIR VENT
Quality Hydronic Heating Specialties
H. A. THRUSH & COMPANY

**Air Vent . . .**

. . . for hydronic systems is used at high points of hot water heating or chilled water systems to eliminate air at up to 50 psi working pressure; with 1/8 in. male inlet, outlet connector for 1/4 in. OD copper overflow; constructed of non-corrosive metals, literature available upon request — *H. A. Thrush & Co., Peru, Ind.*

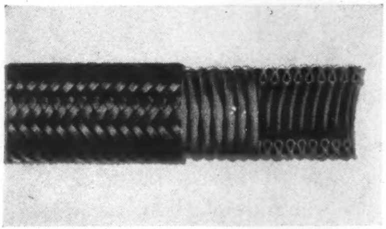
# APPLICATION HINTS:

## Ways to simplify construction and cut costs with Flexpipe®



Four 5-inch Flexpipe Connectors 30″ long and four 3-inch Flexpipe Connectors 18″ long connect pumps with hot water heating mains in big new Detroit Lakes, Minnesota, Senior High School. Architects: Traynor & Hermanson, St. Cloud, Minn. Engineers: Gausman & Moore Inc., St. Paul. Mechanical contractors: Holm Brothers, Atwater, Minn.

## Flexpipe connectors handle expansion on long horizontal runs in big hot water job—eliminate vibration from pumps



**FLEXPIPE'S** flexible core can be either tin bronze, hot-dipped galvanized steel or stainless steel. End fittings (attached): flanges, threaded males and welding nipples.

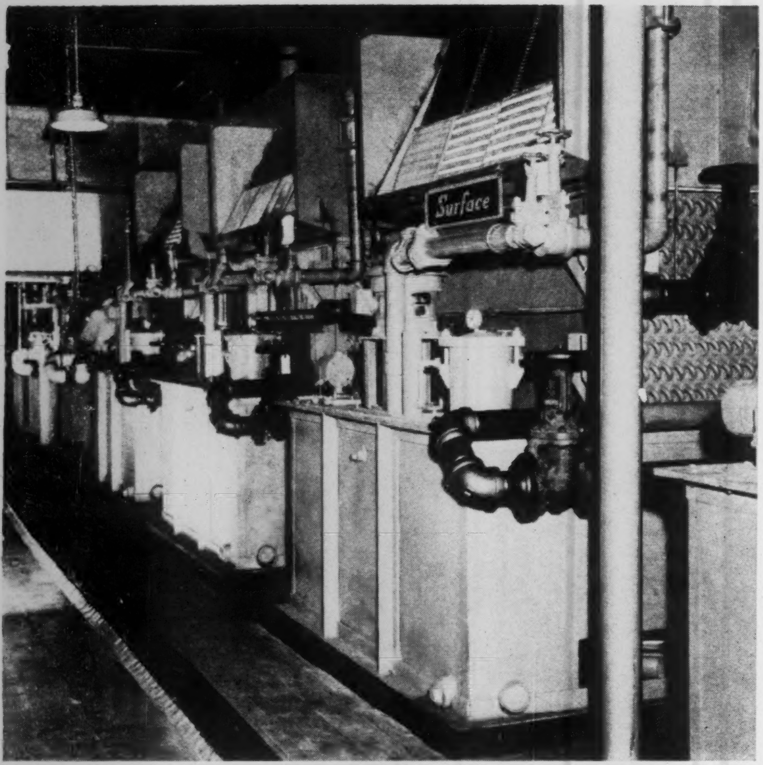
The multi-structure design of many modern schools and institutions often makes necessary long horizontal runs for the heating mains. In hot water systems, it is very desirable, if not essential, to prevent transmission of vibration from the pumps to the mains. Flexpipe flexible connectors are designed for this service—will reduce pump vibration and noise.

Flexpipe connectors at the same time take up expansion and contraction in the mains. Thus in many cases they eliminate the need for expansion bends — make possible smaller, more economical tunnels—simplify and speed installation, reduce maintenance.

**WHERE TO BUY:** Flexpipe connectors come in convenient standard sizes, are sold by leading distributors. For the name and address of the one serving your area, or for more detailed information, write to: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Limited, New Toronto, Ontario.

58227 Rev.

**Flexpipe® an ANACONDA® product**



120 GRAINS CUT TO 45

IN 200,000 cfm OF AIR

WITH 85° TOWER WATER

Without Kathabar, this job would have taken 1800 tons of refrigeration, at about 35F and reheating air from about 45F to 98F! With Kathabar the job took 63 hp instead of 2000. Ask the men who have seen Kathabar Type C units serve for years with practically no maintenance. Write for specific information.

SURFACE COMBUSTION
*Division of Midland-Ross Corporation*
*2384 Dorr St., Toledo 1, Ohio*
*Send facts on Kathabar systems for the following application:*

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*street* ........................................
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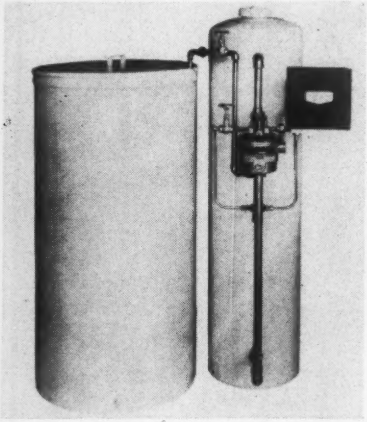
## EQUIPMENT DEVELOPMENTS

*Continued*



**Water Softener . . .**

. . . and combination sediment filter unit designed to remove hardness elements up to 100 grains per gal, iron up to 8 ppm, and remove sediment in one operation; features four step automatic regeneration cycle, automatic multiport valve for down flow softening and filtering, upflow backwashing, with adjustable time cycle; hard water is by-passed during regeneration, tanks are galvanized with baked enamel finish — *Universal Water Softener Co., Geneva, Ill.*

**Damper Regulator . . .**

. . . can be used to set and lock manual dampers in any desired position, consists of 6-5/16 in. diam flange with integral handle connector device; damper blade is installed parallel to handle for indication of position, can be turned when handle is pressed, is locked in position when handle is released; for use with 1, 1-½, or 2 in. thick insulation — *RINCO, P.O. Box 453, Altadena, Calif.*

A New Kind of Paper
That Helps Stop Fires
Before They Start

The bill is higher than ever today when fire interrupts production. That is why architects, engineers and building management think in terms of "total fireproofness". A requirement of this concept is the scrutiny of every element of construction as to its flammability.

An additional contribution to "total fireproofness" has been made with the development of Pyro-Kure® vapor barriers. These U/L rated products (used in construction to eliminate condensation damage) employ paper, foil or plastic film laminations. The special adhesive used emits a gas at combustion temperature which snuffs out the flame making the product self extinguishing.

Pyro-Kure vapor barriers are unique in being *permanently* non-combustible. They have a perm rating of less than 0.1 and are being used as insulation facing, pipe jacketing and duct lining. Leading insulation manufacturers are combining them with their products. Write Dept. AS2 for technical literature and samples on this vapor barrier line.

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**AMERICAN SISALKRAFT CORPORATION**
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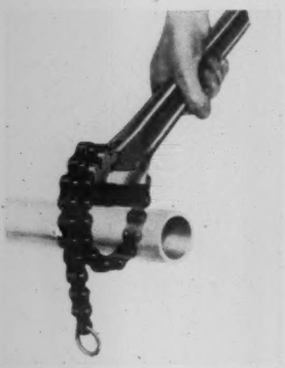
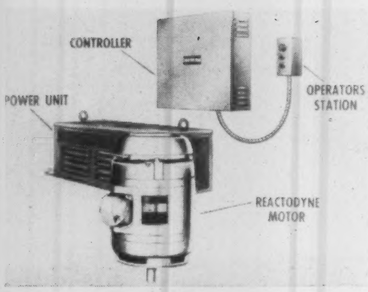
*reinforced paper, foil and plastics for construction, industrial packaging and agriculture*



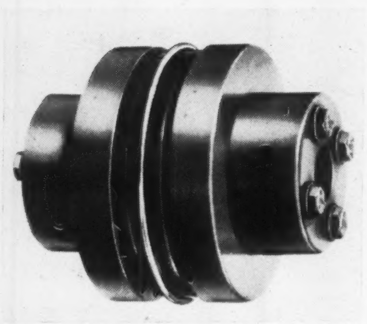
### Chain Wrenches . . .

. . . in two models for use on up to 2 and 2½ in. pipe and fittings, feature ratchet-like action in either direction; said to give tight grip without exerting crushing force on all round, square, or irregular shapes; chain is of tempered steel, with finger ring for adjustment. I-beam type handle is guaranteed not to warp or break, according to manufacturer — *The Ridge Tool Co., Clark St., Elyria, O.*



### Variable Speed Control . . .

. . . for centrifugal pump and fan drives provides variable speed from induction motors, can be used to automatically control pump or fan speeds by means of potentiometer signal actuated by liquid level, temperatures, pressures, etc.; designed for "cubic" loads where torque requirements fall off rapidly at lower speeds, not intended for constant torque loads; operates on 220/440 v 60 cycle a-c, with choice of horizontal or vertical drive motors; available ratings are 1 to 30 hp with 2:1 speed variation — *U. S. Electrical Motors Inc., Box 2058, Terminal Annex, Los Angeles 54, Calif.*



### Spacer Couplings . . .

. . . for connection of motor and pump shafts, other applications, are equipped with detachable hubs which allow coupling of shafts spread apart by as much as 7-½ in., depending upon coupling size; consist of two flanges with two-piece flexible sleeve; sleeve teeth lock with flange teeth and tighten under torque; available in stock bores of from ⅜ in. up to 3-¼ in., units will compensate for angular misalignment of up to 1 deg, parallel misalignment up to 1/16 in., free end float up to ⅛ in. — *T. B. Wood's Sons Co., Chambersburg, Pa.*

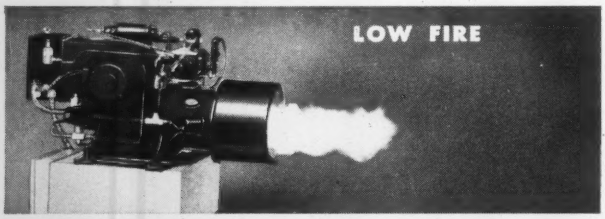
Burner does a

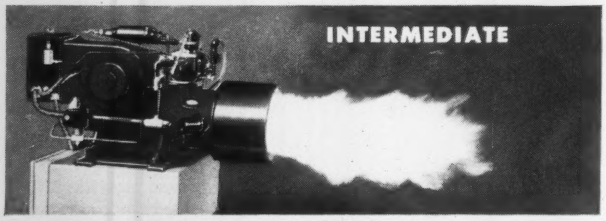
slow burn

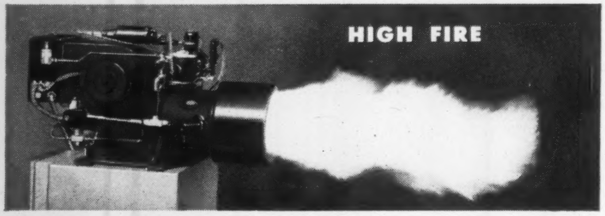
for smooth, economical operation

**HEV-E-OIL BURNERS** start with a low fire, a small flame which gradually builds up to the required size for safe, smooth operation. Low fire and high fire are controlled exactly to assure top efficiency over the entire firing range. Moreover, Hev-E-Oil burners furnish all the primary and secondary air needed for efficient combustion. Available from 5 to 150 gph. Also combination gas/oil burners from 720,000 to 21,000,000 Btu.

**HEV-E-DUTY POWER GAS BURNERS** also utilize slow fire build-up for top performance. Air is metered in correct proportion to the amount of gas being used, resulting in high efficiency regardless of chimney draft caused by outside weather conditions. Sizes from 720,000 to 21,000,000 Btu. For more information on Hev-E-Duty Power Gas, Hev-E-Oil and combination burners, write Dept. HPA-90.



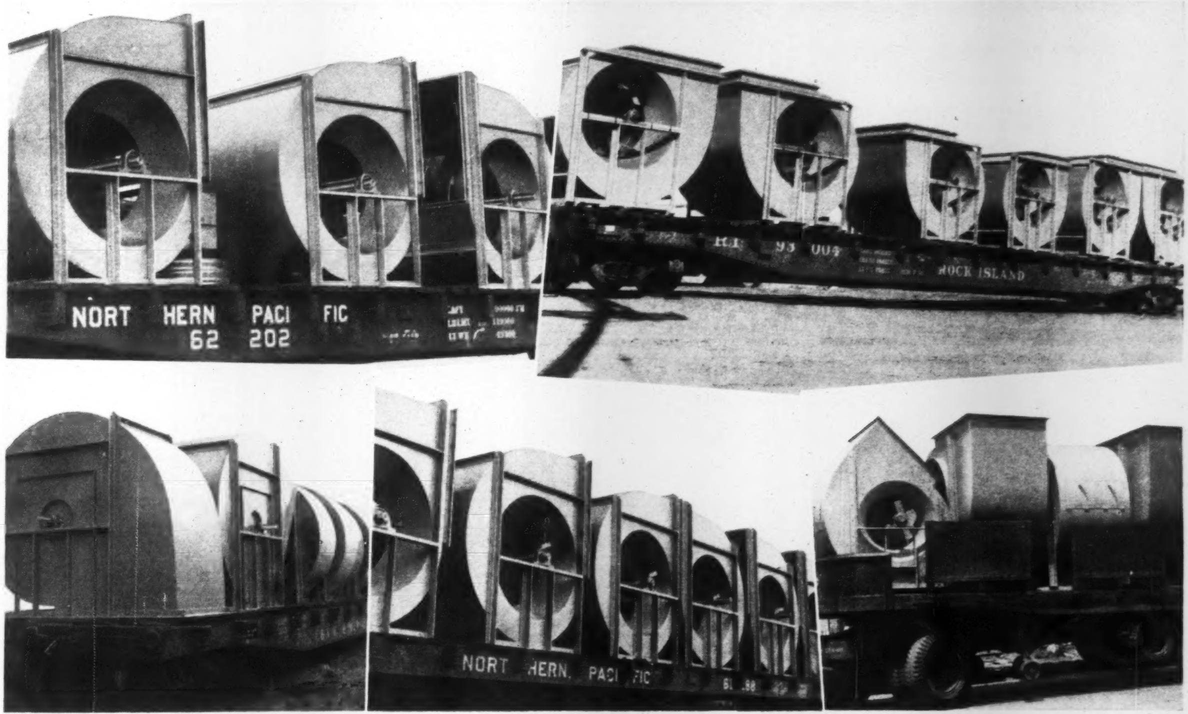




INDUSTRIAL COMBUSTION
INC.
EXECUTIVE OFFICE: 4507 N. OAKLAND AVENUE
MILWAUKEE 11, WISCONSIN

for your large air moving requirements . . .

CALL ON BARRY FOR THE BIG ONES!



**BARRY**

centrifugal fans are engineered to do the job ***RIGHT!***

Yes, big air moving jobs can bring big headaches . . . unless your blower supplier can give you fast delivery on fans that will do the job right. That's where Barry's experience pays off for you!

Barry builds a lot of big fans, and Barry's know-how assures you of speedy delivery on every big blower project. And the same inherent precision, good design, perfect balance and overall attention that regularly goes into our smaller fans will also be found in our larger units.

Whenever you require big volume fan equipment—see your Barry representative. And even if your fan needs are not as large as the blowers shown here, your Barry representative can help you solve all your problems quickly and efficiently!

***fast delivery too!—on fans in all classes from I to IV:—***
***check with BARRY first, you'll save time and money!***

*member of air moving and*
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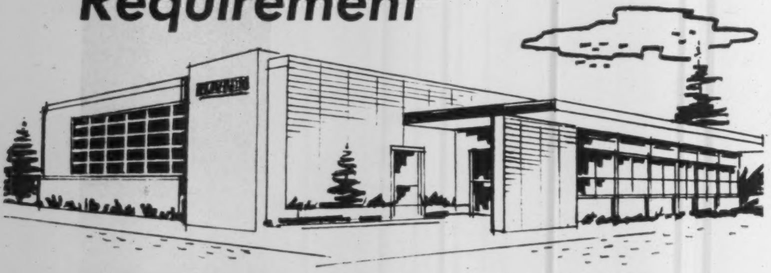
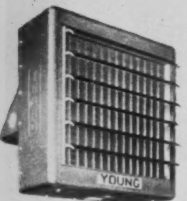
**BARRY BLOWER CO.**
*3100 CALIFORNIA ST. N. E., MINNEAPOLIS 18, MINN.*

FC VENTILATING FANS • INDUCED DRAFT FANS • STEEL PLATE FANS • FAN WHEELS AND SCROLLS • BBC VENTILATION FANS • FORCED DRAFT FANS • FUME EXHAUST FANS • UTILITY EXHAUSTERS • BELTED VENTILATING SETS • MATERIAL HANDLING FANS • MEDIUM PRESSURE BLOWERS • SPECIAL APPLICATIONS

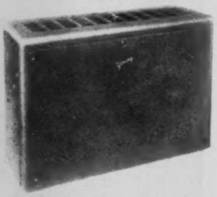
There's a Young Unit Heater for Every Requirement



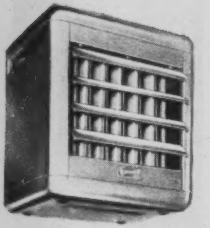
**VERTIFLOW® UNIT HEATERS** by Young are ideal for heating areas with high ceilings and large clear spans. Exclusive cooling stack design prolongs motor life. Wide variety of discharge outlets available. Write for Catalog No. 2659A.



**TYPE H (horizontal) UNIT HEATERS** by Young provide quick dependable heat for factories, garages and service areas where heating requirements are subject to considerable variation. Write for Catalog No. 2557A.



**CABINET UNIT HEATERS** by Young offer maximum heat output in a wide range of capacities and attractive models. Write for catalog No. 6556-A.



**GAS-FIRED UNIT HEATERS** by Young are the answer for fast spot heating in areas where steam or hot water lines are not available. Output from 24,000 Btuh to 184,000 Btuh in wide range of sizes. Write for catalog No. 2760.

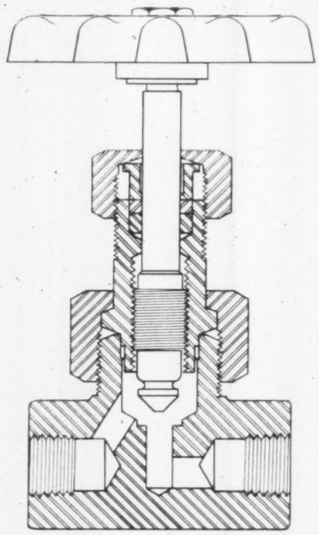
Capacities and piping diagrams are complete in each catalog. Write for one or all.

Young ideas for solving heat transfer problems are GOOD IDEAS

YOUNG RADIATOR COMPANY DEPT. K-510 RACINE, WISCONSIN
PLANTS AT RACINE, WISCONSIN AND MATTOON, ILLINOIS

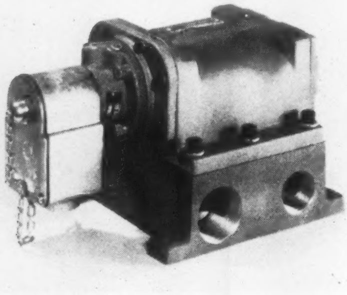
## EQUIPMENT DEVELOPMENTS

*Continued*



**Hand Valve . . .**

. . .of ¼ in. size, for liquid or gas service on meter manifolds, seal chambers, hydraulic units and other applications with line pressures up to 3000 psi; in five variations of globe and angle types, features stainless steel stem which terminates in socket that holds knuckle of conical shaped plug; when plug is seated, stem is free to rotate, preventing scoring of cone; body, bonnet, and union nut are of steel — *The Foxboro Co., Foxboro, Mass.*



**Air Control Valve . . .**

. . .two position, four way poppet type, with ¾, 1, and 1-¼ in. ports, replaceable resilient seals, tapered sealing surface; internal parts are interchangeable with other three and four way valves in line; literature available upon request — *Hoffman Valves, 2360 W. Dorothy Lane, Dayton 39, O.*

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# THE NEW BURNHAM

## 3-PASS SCOTCH-TYPE PACKAGED STEEL BOILER

Here's a high point in efficient, low maintenance heating for schools, office buildings, all commercial and institutional installations! Designed to the latest SBI ratings for Scotch-Type 3-pass low pressure installations, these modern new boilers have certified efficiencies of better than 80%. Flue gas temperatures are in the 400° to 450° range. Perfectly balanced draft conditions between the second and third passes, help make these units outstanding performers. They are available as bare boilers or as complete boiler-burner packages for oil, gas or oil/gas combination firing. Sizes range from 20 to 800 hp. new five sq. ft. fireside heating surface ratings per hp. Write for full details now.

**Also available for prompt shipment:**
**Scotch-Type 2-pass boilers; Compact-Type Table 1 and Table 2 steel boilers.**

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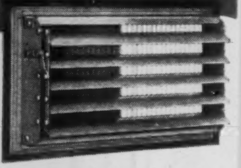
Address ..........................................................

City ................................ State ................................

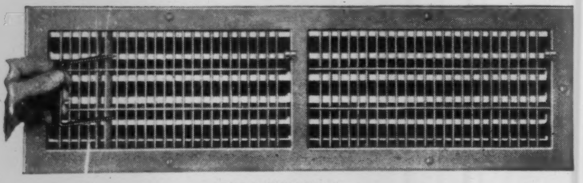
DIRECTED AIR FLOW
at any angle with

INDEPENDENT
"Fabrikated"
REG. U. S. PAT. OFFICE
AIR CONDITIONING
REGISTERS

321-A HMV


Rear View Showing "HMV" Valves

Every grille bar adjustable individually—before or after installation

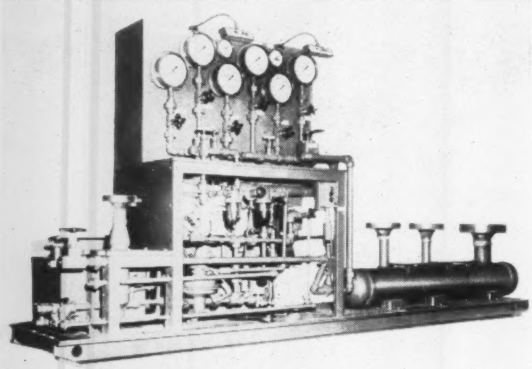

321-A HMV Tandem

Any direction of air flow—right, left, up, down and any combination—is easily obtained with "Fabrikated" Style No. 321-A HMV air conditioning registers, for residence or commercial installations, on sidewalls or ceiling. The face bars are adjustable to right or left; valves on the back are adjustable to direct the air flow up or down; valves may also be fully closed, and are connected to open or close in unison.

The angles of deflection and the combinations to be had are practically unlimited. Adjustments for directed air flow may be made before or after installation. Grille bars are held firmly in place and will not vibrate or rattle. "Fabrikated" registers are available in sizes from 8 x 4" to 48 x 24", including tandem style. Special sizes can be made without special die set-up charges.

Write for Catalog.

THE INDEPENDENT
REGISTER CO.
3747 E. 93rd STREET · CLEVELAND, OHIO

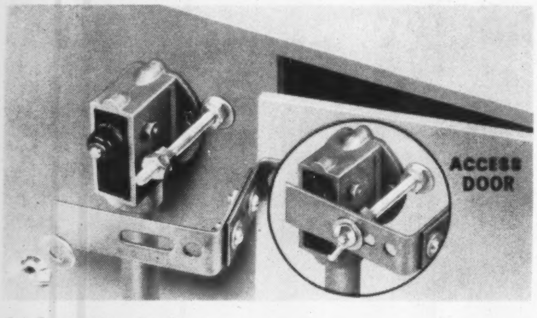


**Valve Test Stand . . .**

. . . will accommodate globe, gate, plug cocks, safety, and relief valves plus other hydraulic and pneumatic equipment, has built-in compressor which can also provide source for plant compressed air supply; controls are mounted on single panel with instructions on testing at pressure settings of up to 2000 psi air and 6000 psi water—*Farris Engineering Corp., 563 Commercial Ave., Palisades Park, N.J.*

**Motor Starter Panelboards . . .**

. . . designed to replace wall-mounted separate devices are rated at 600 v a-c maximum, with magnetic starters in NEMA sizes 0 through 3 for motors up to 50 hp; starters are mounted in twin unit construction and are arranged for mounting directly below disconnect devices; starter line terminals wired to either circuit breakers or fusible switches, each starter individually compartmentized; bulletin "GEA-6728" available upon request—*General Electric Co., Distribution Unit, 90 Whiting St., Plainville, Conn.*



**Safety Switch . . .**

. . . for use on access doors leading to air conditioning system plenums or other chambers where personnel shock hazard exists utilizes wing nut which must be manually unscrewed, interrupting primary power and preventing power resumption by accidental door closing; switch cannot be locked on with door open; contacts rated at 15 amps, 125 v a-c, for left or right door openings — *CRS Industries, Inc., 1405 Locust St., Philadelphia 2, Pa.*

WELCOME
SITE
*
FOR
REFRIGERANT
USERS

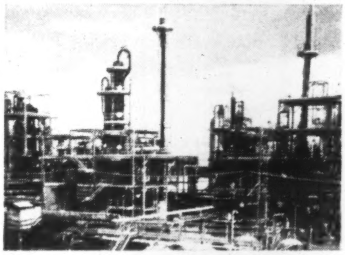
# *General Chemical announces a new genetron® plant in Elizabeth, N. J.

Soon east coast air-conditioning and refrigeration wholesalers and original equipment manufacturers will be "next door" to a new source of "Genetron" Super-Dry Refrigerants. General Chemical has started construction of large new "Genetron" manufacturing facilities at its Elizabeth, N. J. works.

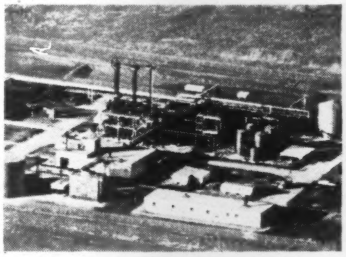
This will be the third "Genetron" plant, supplementing those in Baton Rouge, Louisiana, and Danville, Illinois, and increasing our over-all production capacity by more than one third.

This new "Genetron" plant is another example of General's efforts to serve the growing needs of the air-conditioning and refrigeration industry and will reflect the advanced manufacturing and process control techniques which have grown from General Chemical's leadership in fluorine chemistry.

"Genetron" Super-Dry Refrigerants are stocked by all leading wholesalers coast to coast. Insist on the best . . . insist on "Genetron" Super-Dry Refrigerants from *your* wholesaler.



**BATON ROUGE, LA.**—From this giant fluorochemical center shipments of "Genetron" Super-Dry Refrigerants speed to wholesalers and equipment manufacturers and to our "Genetron" stock points throughout the nation.



**DANVILLE, ILL.**—General Chemical's Danville plant assures Midwest users of a dependable supply of "Genetron" Super-Dry Refrigerants. This plant also backs up supply to General Chemical's nationwide network of stock points.

**genetron®**

super-dry
refrigerants

Allied
Chemical

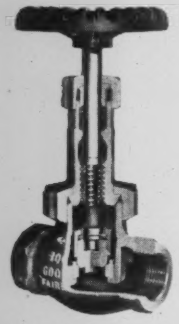
**GENERAL CHEMICAL DIVISION**
**40 Rector Street, New York 6, N. Y.**

*The More You Know About Valves,*
*The Surer You Are To Specify*

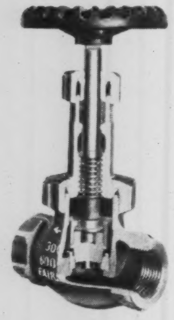
**FAIRBANKS**

**READ THESE FACTS,** *About Just 3 Bronze Globe Valves Of Fairbanks Complete Line Of Bronze And Iron Body Valves*

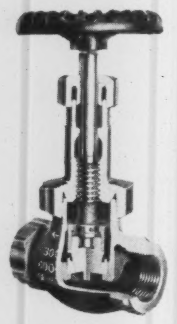
**TO LEARN WHY MEN WHO KNOW VALVES AGREE THAT FAIRBANKS VALVES LOWER MAINTENANCE COSTS AND GIVE LONGER SERVICE, EVEN UNDER THE MOST DIFFICULT OPERATING CONDITIONS.**



**Full-Port 200 Brinell Nickel Alloy Radial Disc and Seat.**
Fig. 0541—Globe, Fig. 0543—Angle, Sizes ¼ thru 2 inches. Made to give full flow on high pressure, high temperature steam, water, gas, oil and air lines.



**Full-Port 500 Brinell Stainless Steel Plug Disc and Seat.**
Fig. 0545—Globe, Fig. 0547—Angle. Sizes ¼ thru 2 inches. Designed for full flow when fully opened and for severe service of throttling and frequent operation.



**Throttle-Port 500 Brinell Stainless Steel Cone-Plug Disc and Seat.**
Fig. 0551—Globe, Fig. 0553—Angle. Sizes ¼ thru 3 inches. Recommended for most severe service and where constant throttling is required.

Service: 300# Steamworking pressure at 550° F.; 600# Cold Water, Oil or Gas Pressure—Non Shock.

Fairbanks features: Two-Piece Radial Seat Union Bonnet, a true ball and socket connection assures a tight seal time and again and facilitates the removal of the bonnet assembly for the regrinding or placement of the disc and seat. Bottom-seated Seat Ring has tight seal on pressure side. Valves may be repacked under pressure when wide open. Protected Top Seat, above stem threads and out of stream flow, makes a tight seal when valve is full open. All parts of three valves may be interchanged size for size and type for type.

**Buy Through Distributors.** Fairbanks products are stocked, sold and recommended by leading distributors in all the principal cities across the nation.

THE **Fairbanks** COMPANY
**Executive Office:** 393 Lafayette Street, New York 3, New York
Valves • Dart Unions • Casters • Trucks • Wheels

520 Atlantic Ave.
Boston 10, Mass.

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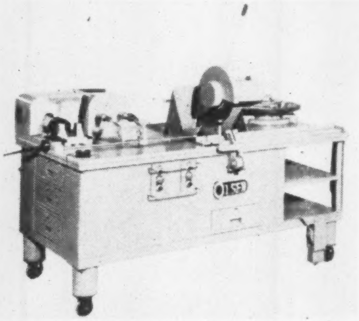
Rome, Ga.

Factories — Binghamton, N. Y. and Rome, Ga.

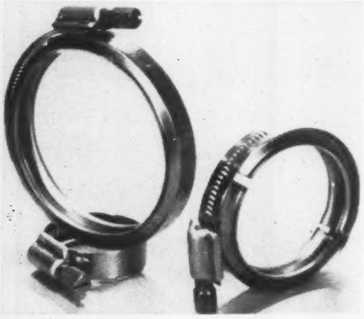
## EQUIPMENT DEVELOPMENTS

*Continued*



**Tubing Machine . . .**

. . . cuts, deburrs, flares, bends 1/4 to 2-1/2 in. tubing including heavy wall, ferrous, non-ferrous, and stainless steel; abrasive blade yields square cut, inside and outside deburring heads and power flare unit are arranged according to order of use; power threading vise may be substituted for flare machine to facilitate fitting of threaded pipe; literature available upon request — *Olsen Mfg. Co., 1622 Delemere Blvd., Royal Oak, Mich.*



**Hose Clamps . . .**

. . . and V-band couplings designed for use in joining hose and pipe where extreme pressure and vibration is encountered feature worm drive, stainless steel construction, greater contact area between worm thread and slotted receivers for increased joint support; tightening screw is slotted for screwdriver and hexagonal for wrench; hose clamps available in sizes from 1 to 6-1/4 in. diameters; V-band couplings for joining of flanged taper joints of pipe, ducts, tubing, are also of stainless steel, in sizes from 3 in. diameter up —*Federal Laboratories, Inc., Dept. 7-C, Saltsburg, Pa.*

## You're in luck when you look to ILG® for unit heaters

Next time you need unit heaters, all you need do is look to Ilg. For *only* Ilg has everything you want . . . *all four types of heaters.*

Whether you prefer all-electric, gas-fired, steam or hot-water units, Ilg can meet your preference with a variety of sizes and types.

**Ilg All-Electric Unit Heaters.** Sizes from 1½ kw., 5118 BTU/hr. to 36 kw., 122,832 BTU/hr. Non-glowing, steel-sheathed, black-heat type with replaceable heating elements. Built-in thermal cutout protection against overheating. Quiet operating with Ilg type Q fan wheel.

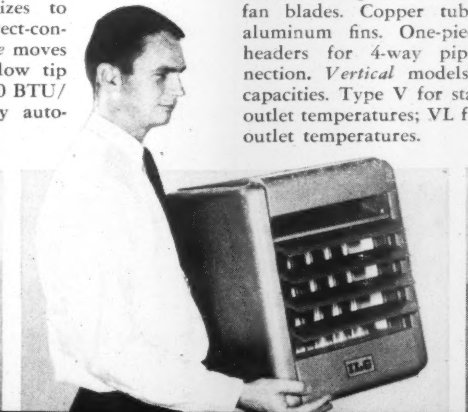
**Ilg Gas-Fired Unit Heaters.** *Propeller type* is lightest, smallest on market. 10 sizes to 250,000 BTU/hr. Direct-connected. *Centrifugal type* moves large air volumes at low tip speed. 8 sizes to 250,000 BTU/hr. V-belt drive. Fully automatic controls.

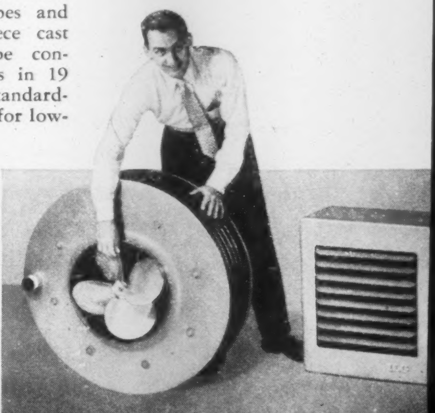
Why shop around? Select all your unit heaters from a single source—Ilg. For further details on electric heaters, write for Bulletin 809; for gas-fired heaters, Bulletins 1501 and 286; for steam and hot-water, Bulletin 357.

ILG®

**ILG ELECTRIC VENTILATING CO.**
2826 N. Pulaski Road
Chicago 41, Illinois
Offices in 60 principal Cities
Member of Air Moving and
Conditioning Association, Inc. (AMCA)

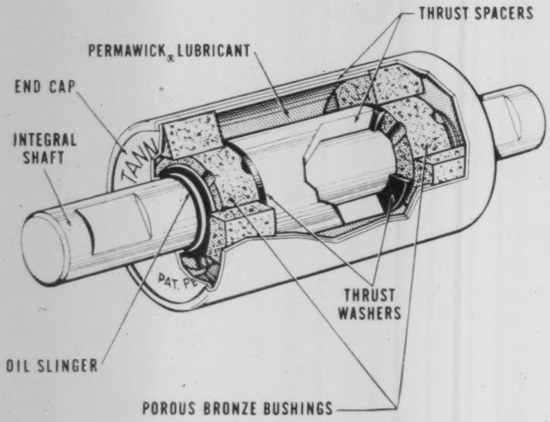
**Ilg Steam and Hot-Water Unit Heaters.** *Horizontal* models in 19 capacities. Aluminum fan blades. Copper tubes and aluminum fins. One-piece cast headers for 4-way pipe connection. *Vertical* models in 19 capacities. Type V for standard-outlet temperatures; VL for low-outlet temperatures.





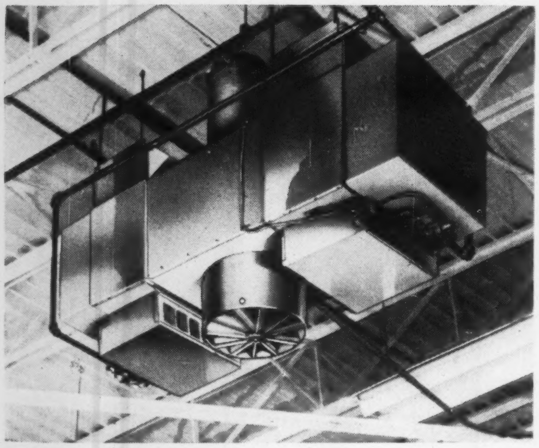
## EQUIPMENT DEVELOPMENTS

*Continued*



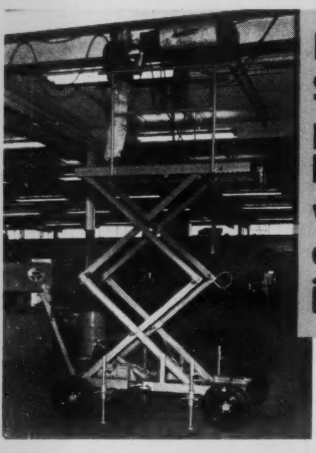
**Blower Wheel Bearing . . .**

. . . assembly can be supplied with integral shaft contoured to accept blower fittings, has permanent recirculatory oiling system, is designed to handle radial loads of 25 to 30 psi at speeds of 500 to 4000 rpm with moderate thrust loads; presently available with 1.181 in. OD and shaft diameter of 0.4995 in., with other sizes to come—*Tann Bearing Co., 2741 East Congress, Detroit 7, Mich.*



**Industrial Heaters . . .**

. . . gas fired vertical discharge units designed for installation at heights up to 36 ft, heating capacities from 30,000 to 600,000 Btu per hr input; with ½ to 1 hp motors, stainless steel burners and stainless or aluminized steel heat exchangers; units can also be used for makeup air ventilation purposes; weights range from 383 to 680 lb, permitting suspension from most existing structural members; for use with natural, mixed, and LP gas, bulletin "IGV-660" available upon request—*Modine Mfg. Co., 1509 De Koven Ave., Racine, Wis.*



**NEW SKY WITCH puts load and workmen at job height!**

**Work height easily varied with a touch of the controls**

*Sky Witch, the new* ***CHARLES*** *product, is a...*

**WORK-LOAD LIFT!**

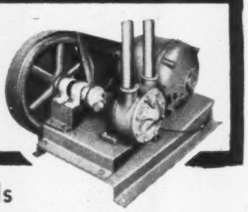
**For construction, installation, and overhead maintenance . . . in industrial plants and commercial buildings . . . chemical plants, refineries . . . inside or outside! Sky Witch offers 6 basic models with various power and mounting options. Portable and hydraulic, it lifts the load and serves as an adjustable work platform . . . heights to 24 feet, loads to 2,000 pounds! Write for details.**

**CHARLES Machine Works, Inc.**

**1530 B. STREET • PERRY, OKLAHOMA • FE 6-4404**

**TUTHILL**

**SU PUMP UNIT**



- **For handling heavy oils**
- **In packaged boiler or commercial heating applications**
- **Economically priced**

Specifically developed for heavy fuel oils, in commercial heating applications and packaged boilers, the SU unit is compact . . . measures only 24¼" x 14⅝". Quiet operation insured by the 2 or 4 V-belt drive and integral gear positive displacement pump.

Quality construction features for dependability, low maintenance include two ball bearing pillow blocks, one point take up for simple adjustment of belt tension, removable belt guard, fabricated steel base motor mounting.

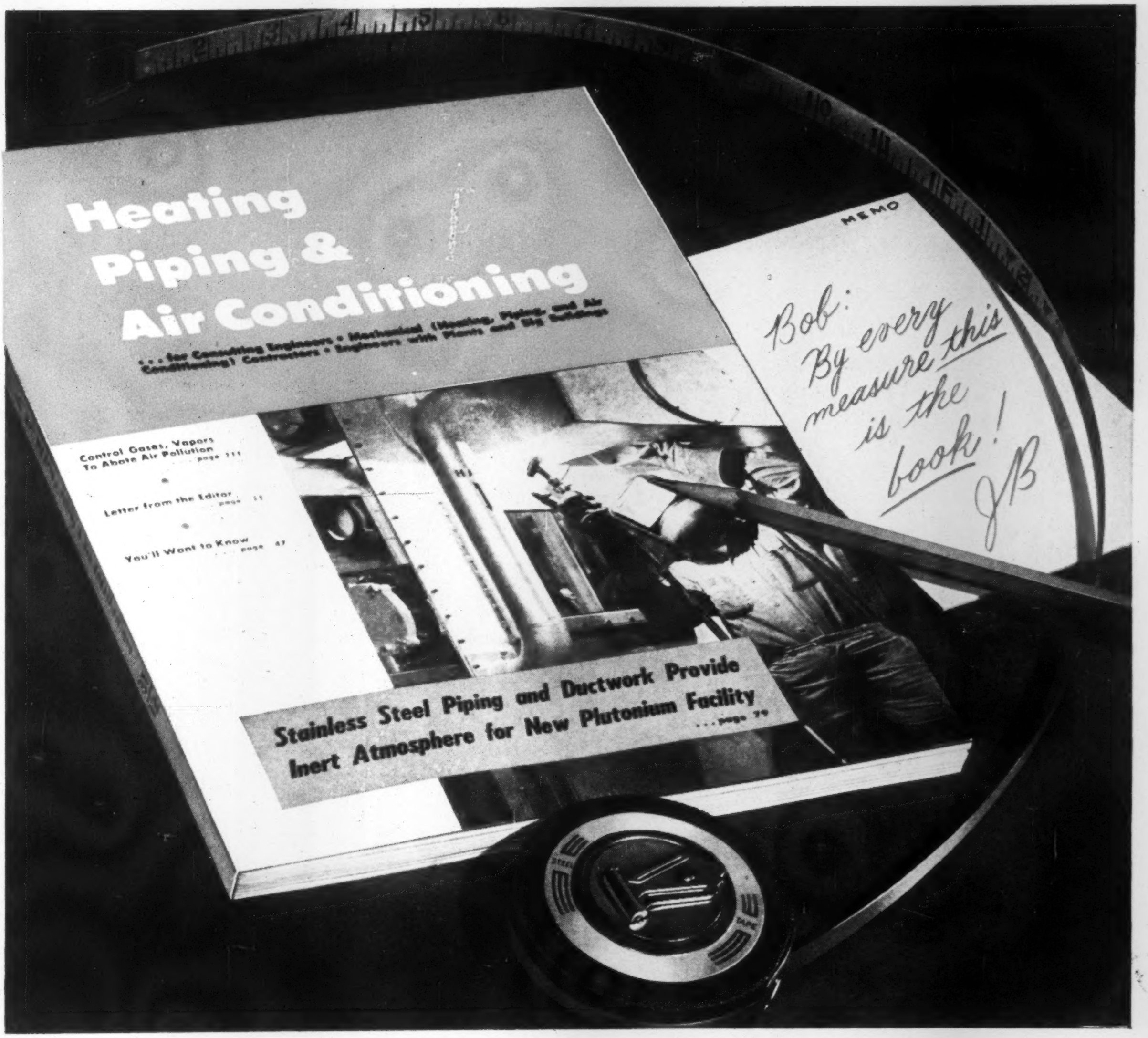
Furnished with wide variety of pumps and motors for pressures to 300 psi, capacities to 2030 gals. per hr. Subassemblies of pump, stub shafts, pillow block and sub-base also provided separately as a unit for incorporation into systems by boiler and furnace manufacturers.

*Write today for Catalog 107.*

PUMPS FOR YOUR PURPOSE

**TUTHILL PUMP COMPANY**

947 East 95th Street, Chicago 19, Illinois


Heating
Piping &
Air Conditioning
. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings
Control Gases, Vapors To Abate Air Pollution . . . page 111
Letter from the Editor . . . page 11
You'll Want to Know . . . page 47
Stainless Steel Piping and Ductwork Provide Inert Atmosphere for New Plutonium Facility . . . page 79
MEMO
Bob:
By every
measure this
is the
book!
JB

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## *your best buy*
## *...and here's why!*

Faithful to its name, Heating, Piping & Air Conditioning confines itself to these three services as related to just the industrial-large building field.

Result: a specialized editorial content vital to all of the purchase-control factors in this market — the consulting engineers, mechanical contractors, and engineers with plants and big buildings who identifiably are responsible for heating, piping and air conditioning services.

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FORCED-AIR FURNACE—Gas Fired
DBF Series (Standard)
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PACKAGED BLOWERS
K Series
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US-BE Series (Standard)
LUS-BE Series (Unitemp)
FUS-BE Series (Flexitemp)
WAY HEATER—Gas Fired
DFAH Series
REZNOR VENTER
V Series
HEAVY DUTY HEATERS
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S Series
REZNOR
The World's Largest Selling Direct-Fired Heater
REZNOR MANUFACTURING COMPANY
MERCER, PENNSYLVANIA

SELL MORE "TOUGH CLIENTS" WITH REZNOR...

more types and sizes of direct-fired heaters to choose from!

Now you can satisfy "tough clients" with just the right model heater for every job. The Reznor line features more types and sizes than any other! Choose from:

- Money-saving, space-saving unit heaters with three control options, propeller or blower fans, 25,000 to 30,000 Btuh.
- Low cost, versatile duct furnaces in capacities of 50,000 to 300,000 Btuh and up, for central heating, year-round air conditioning, or heating of make-up or process air.
- Matching, quiet-operating blower packages, if a separate air handler is needed.
- The new Reznor Venter, an automatic vent exhauster that lets you install Reznor unit heaters almost anywhere.
- Effective, five-way heaters for high ceiling applications, 300,000 to 600,000 Btuh.
- Heavy duty, forced air heaters, 400,000 to 2,000,000 Btuh, that you can floor-mount or suspend, and use with air discharge nozzles or ductwork.

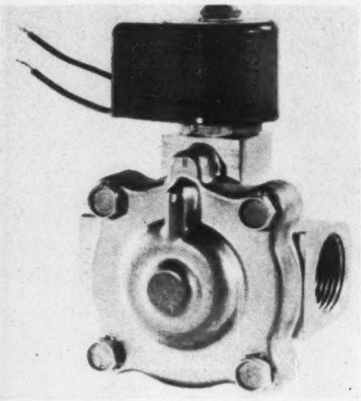
Ask your Reznor representative for a copy of Catalog SA-5900, with complete data on all Reznor heaters. Or write Dept. 51R, Reznor Manufacturing Co., Mercer, Pa.

REZNOR HEATERS

"WORLD'S LARGEST SELLING DIRECT-FIRED HEATERS"

## EQUIPMENT DEVELOPMENTS

*Continued*



**Solenoid Valve . . .**

. . . of 2-way design, with 1 in. pipe connections, forged brass body and bonnet in normally closed or normally opened models, has only three moving parts, can be mounted in any position; diaphragm spring and solenoid core are stainless steel, operates on 10-½ w a-c or 10 w d-c for any voltage up to 550 a-c or 250 d-c; form "V5071" available upon request — *Automatic Switch Co., Florham Park, N.J.*

500
1000
1500
2000
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pyrotroller
alnor

**Indicator-Controller . . .**

. . . combines electronic on-off controller and pyrometric temperature indicator in single case for wide variety of applications; available in 11 ranges from 0 to 400 F up to 0 to 3000 F, plus environmental test chamber range of −100 to 300 F; in single and double target models — *Alnor Instrument Co., Div. of Illinois Testing Laboratories, Inc., 418 N. LaSalle St., Chicago 10, Ill.*

# IN A NEW OHIO LANDMARK

*New Veterans Neuropsychiatric Hospital in Brecksville (suburban Cleveland), Ohio. Designed and supervised by the Veterans Administration. Gust K. Newberg Construction Co., general contractor. Spohn Heating & Ventilating Company, plumbing and heating contractor.*

## *Republic Steel Pipe*...100 tons of it for Cleveland's new Veterans Administration Hospital

Steel pipe was specified for waste, vent, steam, and condensate return lines. Steel pipe is perfectly dependable in these applications... steel pipe costs less installed.

By completion early in 1961, more than 10 carloads of steel pipe will have been installed. Republic Pipe—one of three brands used—was selected and installed by Spohn Heating and Ventilating Company, plumbing and heating contractor.

Your Republic distributor delivers pipe as it is needed on the job... clean pipe that has been stored under-roof. Call him today for complete details of his helpful service.

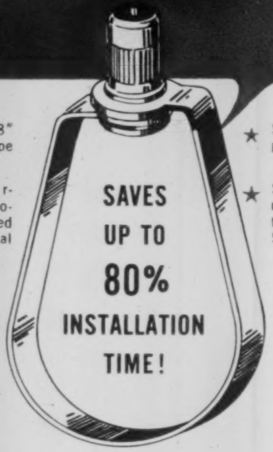
*INSIST ON PIPE MADE IN THE U.S.A.*

**Phone your local distributor for fast delivery of...**

**REPUBLIC Steel Pipe**

REPUBLIC STEEL

NEW! ENGINEERED SELF-LOCKING TIME-SAVING PIPE LOOP HANGER



- ★ Fits all ½" to 8" metal or plastic pipe
- ★ Listed by Underwriters' Laboratories, Inc., Approved by Factory Mutual Laboratory
- ★ Self-locking, compact, attractive
- ★ Safe load exceeds rating for standard types—safety factor 5:1

*"AUTO-GRIP" was designed by "Automatic" Sprinkler Corporation industrial engineers for their own use as piping installation contractors. "AUTO-GRIP" ease, simplicity, speed and economy soon established it in the trade as the top improvement in pipe hanging efficiency in 50 years!*

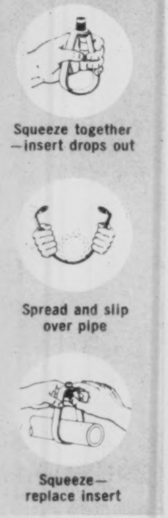
***LOWER INITIAL COST***—competitive with least expensive outmoded, cumbersome rings, bands and clevises.

***SMALLER INVENTORY***—universal adaptability permits quantity buying of fewer types—less storage space.

***SAFER—MORE ATTRACTIVE***—self-locking via spring tension and pipe weight . . . shipped assembled, stays assembled . . . zinc-coated or copper-plated.

***REDUCES LABOR COSTS***—tests by industrial engineers reveal that "AUTO-GRIP" installs in only 20% of the time required for old-fashioned clevis-type rings. Universal, counterbored hanger insert secures quickly to ceiling hanger rod. Insert is adjusted easily on rod by finger strength.

HOW "AUTO-GRIP" WORKS


Squeeze together—insert drops out

Spread and slip over pipe

Squeeze—replace insert

***FREE SAMPLE • TIME-SAVING DATA • MAIL COUPON TODAY!***

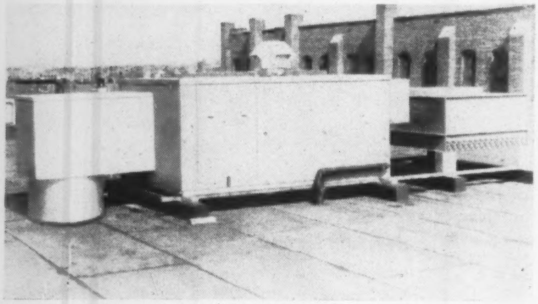
NAME________________ POSITION________
COMPANY________________
ADDRESS________________
CITY________________ ZONE______ STATE________
#260

AUTO GRIP

**"Auto-Grip" Division**
® Box 360 • Youngstown 1, Ohio
"Automatic" Sprinkler CORPORATION OF AMERICA

## EQUIPMENT DEVELOPMENTS

*Continued*

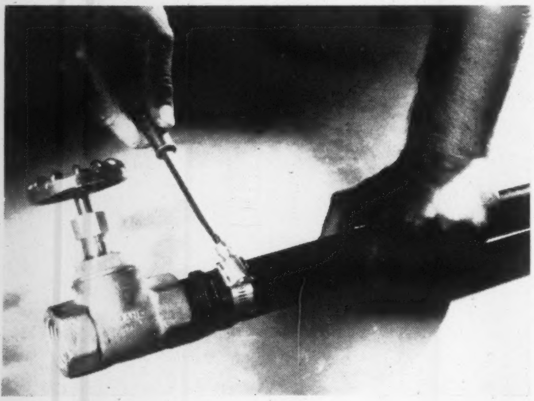


### Year 'Round Air Conditioner . . .

. . . for roof mounting offers cooling capacities of 8 or 10 tons, heating capacities of 160,000 or 240,000 Btu per hr from factory assembled cabinet only 43 in. high; with gas fired heater, hermetic compressor cooling unit in single housing, air cooled condenser in separate package that may be mounted adjacent to or remote from other cabinet; air supply and return effected through one end of main unit which may be positioned over space to be conditioned or with short duct runs—*Typhoon Air Conditioning Div., Hupp Corp., 505 Carroll St., Brooklyn 15, N.Y.*

### Sealing Tape . . .

. . . for threaded pipe joints and cable connectors is offered in dry strip form for direct wrapping of joints; can be used on steel, brass, iron, plastic, aluminum, monel, synthetic rubber, other materials, is supplied in ½ in. widths, 25, 50, and 75 yd lengths; for temperatures from −250 to 500 F — *Hitemp Wires, Inc., 1200 Shames Dr., Westbury, N.Y.*



### Plastic Pipe . . .

. . . and insert fittings of high density polyethylene and polypropylene respectively available in sizes ½ through 2 in.; applicable for piping of corrosive acids, brine, and alkaline solutions—*Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.*

# THE NEW, TIGHT-CLOSING PRESSURE REDUCING VALVE THAT *CAN'T FOUL*

If you like a simple, straight-forward solution to vexing valve problems, you're bound to be impressed with the new line of Leslie-Topper Pressure Reducing Valves. To avoid valve fouling, Leslie Engineers developed a tight-closing valve with an internal pilot that's completely out of the path of steam—*it just can't foul*. Let imaginative engineering simplify valve design and you get results.

Here's the one pressure reducing valve that handles poor steam conditions, intermittent or standby service better than any other valve. It provides high accuracy of regulation with negligible dead-end build up and costs only pennies for maintenance.

New, patented Leslie-Spiroflex* all metal diaphragm insures years of outstanding valve performance. It makes a long valve stroke possible in a packless design—there's nothing to leak, nothing to bind. It's time for a change when you can get rid of the cost and bother of fussy, old-fashioned pressure regulators.

*Trademark of Leslie Co.

**Leslie-Topper Selection Table**

| Size | Inlet Pressure PSI | Adjustable Pressure Range PSI | CLASS | | |
|---|---|---|---|---|---|
| | | | Cast Iron Construction | Bronze Body Construction With Iron Superstructure Castings* | All Bronze Construction |
| ½" TO 1¼" | UP TO 150 | 2 - 10 | GKLL | GLL | GBLL |
| | OVER 125 | 2 - 10 | GKL | GL | GBL |
| | UP TO MAXIMUM BODY RATING | 5 - 20 | GKM | GM | GBM |
| | | 15 - 35 | GKH | GH | GBH |
| 1½" TO 2" | | 2 - 10 | GKL | GL | GBL |
| | | 5 - 20 | GKM | GM | GBM |
| | UP TO 150 | 5 - 35 | GKHL | GHL | GBHL |

*All parts in contact with controlled fluid are of bronze.

For sizing and capacity data write for Bulletin 582 or contact your Leslie Engineer—he's listed in the Yellow Pages under 'Valves' or 'Regulators'.

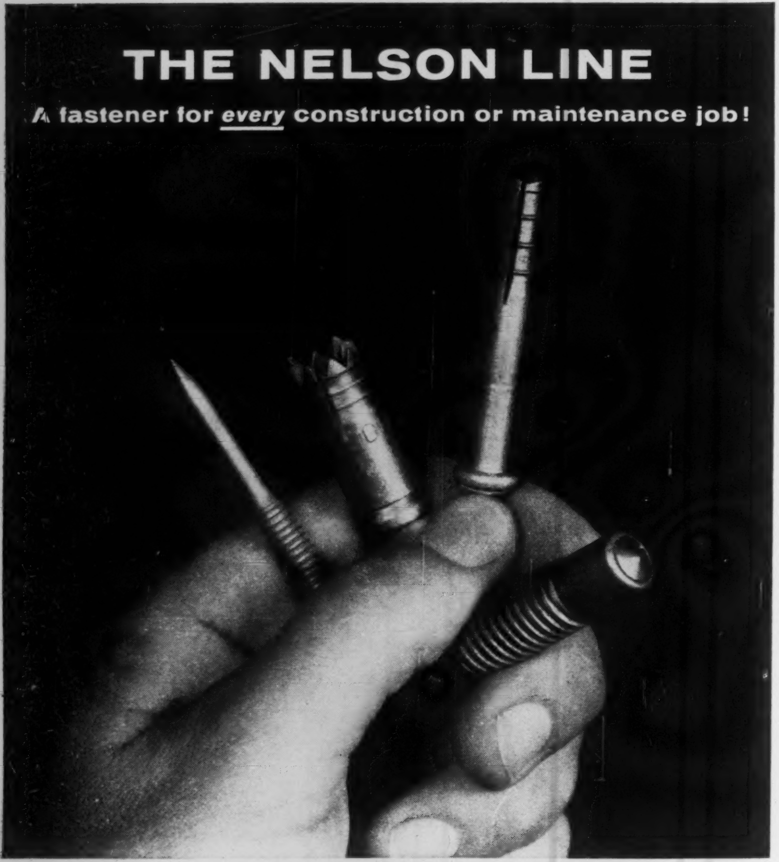
**Leslie Co., 703D Grant Ave., Lyndhurst, New Jersey**

LESLIE TOPPER
REDUCING VALVE
CLASS G
RANGE 2-10
FOR INLET PRESSURE
TO 300 PSI
FOR SERIAL NO. SEE
DIAPHRAGM FLANGE
PATENT NO. 2855002
1
LESLIE

This new Leslie-Topper Pressure Reducing valve is a part of Leslie's expanding line of control valves, regulators and pilots for steam, air and liquids.

TRADE
LESLIE
MARK

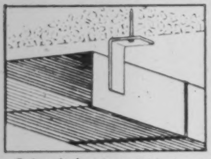
## REGULATORS and CONTROLLERS



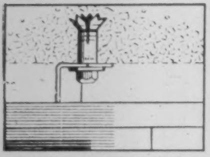
THE NELSON LINE

A fastener for *every* construction or maintenance job!

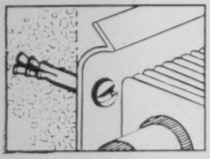
TYPICAL APPLICATIONS



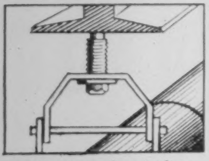
Drivestuds—Suspended Duct



Drill/Anchor—Suspended Heater



Drive/Anchor—Convection Heater



Stud Welding—Suspended Pipe

**NELSON DRIVESTUDS**—For powder-actuated fastening of wood or metal to concrete or steel. No drilling, no chipping ...more fastenings per hour with the NELSON Stud Driver.

**NELSON BULLDOG DRILL/ANCHORS**—No special drills to buy...eliminates time-consuming drilling and use of old-fashioned anchors. Save on labor—save on material costs.

**NELSON BLUE-CHIP DRIVE/ANCHORS**—All-steel ¼" combination bolt and anchor. Fast installation, low-cost fastening. Can be used in masonry, brick, and wood.

**NELSON STUD WELDING**—Split-second end-welding to steel and aluminum. Eliminates costly clamps, drilling and through-bolting.

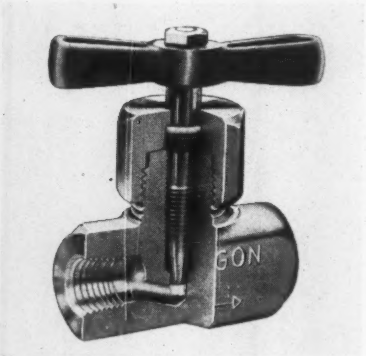
**GREGORY INDUSTRIES, INC.**
*WAREHOUSES COAST-TO-COAST*

GREGORY INDUSTRIES, INC., 102-10 Toledo Avenue, Lorain, Ohio
Please send details about:

☐ NELSON® STUD DRIVERS
☐ NELSON BULLDOG Drill/Anchor
☐ NELSON Blue Chip DRIVE/ANCHORS
☐ NELSON® STUD WELDING

NAME ____________ TITLE ____________
COMPANY ____________
ADDRESS ____________
CITY ____________ ZONE ____ STATE ____

## EQUIPMENT DEVELOPMENTS
*Continued*

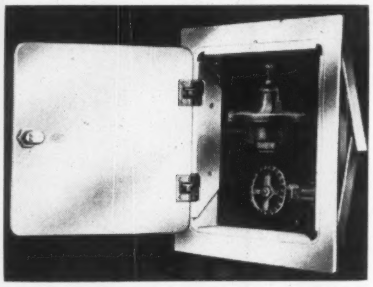


### Needle Valve . . .

. . . rated for 10,000 psi features design innovations to prevent valve stem from blowing or backing out under pressure by means of integral inside neck threads; with stainless steel stem, "Teflon" backup ring, O-ring stem seal; literature available upon request — *Dragon Engineering Co., P.O. Box 185, Norwalk, Conn.*

### Thermal Coatings . . .

. . . for protection of metals at constant heat for all temperatures up to 1400 F plus resistance to corrosive environment offered in 10 mixtures for various temperature ranges; bulletin "1570" available upon request — *The Dampney Co., Hyde Park, Boston 36, Mass.*

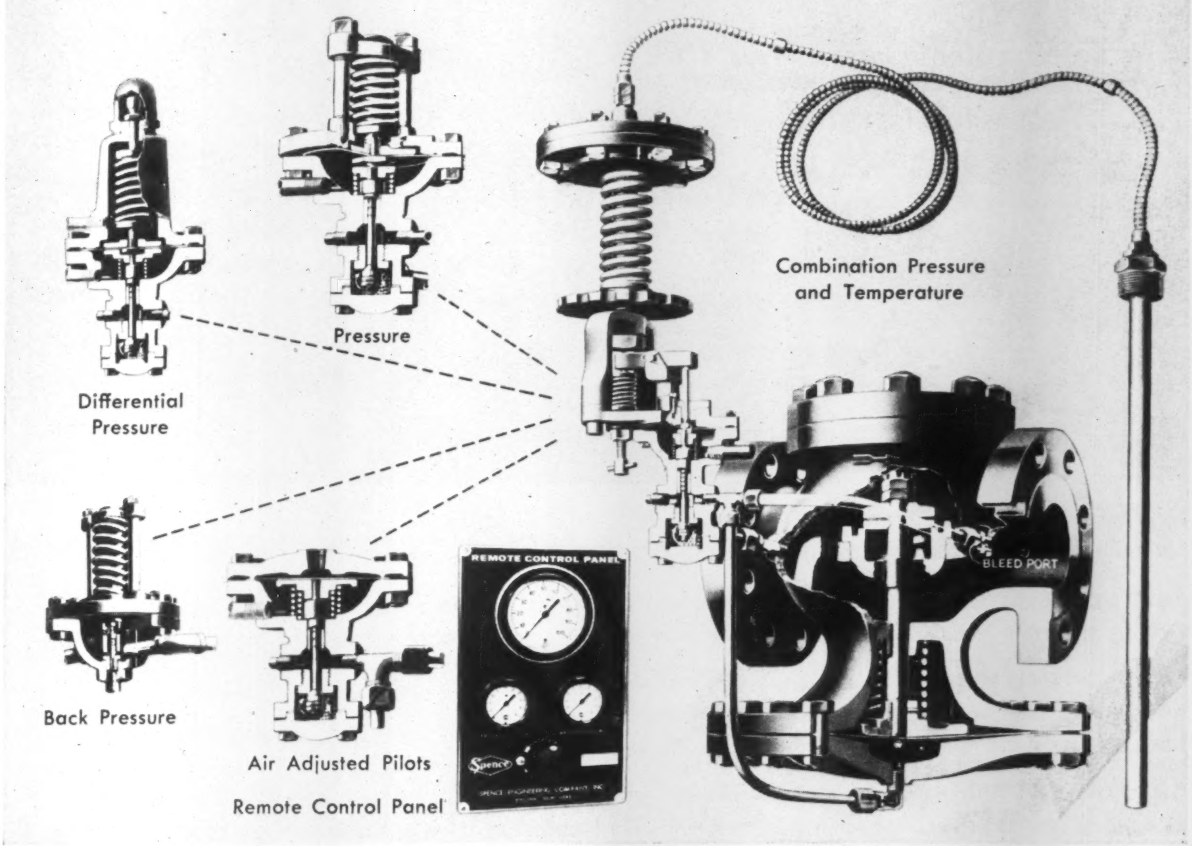


### Access Door . . .

. . . for mechanical or electrical outlets, of stainless or chrome plated steel, or coated steel for use in painted areas; features flush frame and hidden hinges, door has rounded safety corners and protective cylinder lock, swings 180 deg to open for unobstructed access; manual "54-7" available upon request — *Zurn Industries, Inc., 1810 Pittsburgh Ave., Erie, Pa.*

**VALVE TIPS:**

# *All Pilots Fit All Main Valve Sizes Downtime, Maintenance, Inventory Reduced*



Let's start off by admitting there's no such thing as a "maintenance-free" regulating valve. Any valve that automatically controls temperatures or pressures within close limits can be affected by dirt in steam lines.

If trouble does develop, engineers want a regulator they can get back on the line — fast. That's one reason why more engineers are standardizing on Spence Regulating Valves with externally mounted pilots. The simple test of disconnecting the external bends establishes whether the trouble is in the main valve or the pilot.

If the main valve is the trouble spot, it can be maintained without removing the valve body from the line. If the pilot is the trouble spot, it is easily removed for cleaning. However, if production downtime is a strong factor, the fastest method is to install a spare pilot and it is inexpensive.

All Spence pilots fit all sizes of Spence main valves. If you have twenty pressure regulators, for instance, all you need is *one spare pilot*. It will fit all main valve sizes from ¼" to 12".

Another advantage of the Spence design is the external pilot is interchangeable. You can change the function of a regulator by merely changing the pilot. In many plants this can represent an important factor in reduced inventory costs because you only carry a few inexpensive extra pilots instead of complete regulators. Obviously, there is also a considerable savings in labor costs when a valve can be converted, in the line, from a temperature regulator to any one of various pressure regulators.

The pictures above show a few of Spence's wide line of automatic regulators. For more information write for Bulletin TE.

**SPENCE ENGINEERING COMPANY, INC.**
***Walden, New York*** SE-145

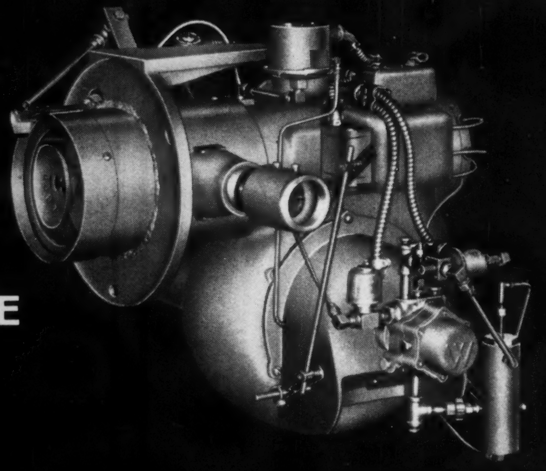
# new RAY Forced Draft Burners—

CUT
CONSTRUCTION COSTS

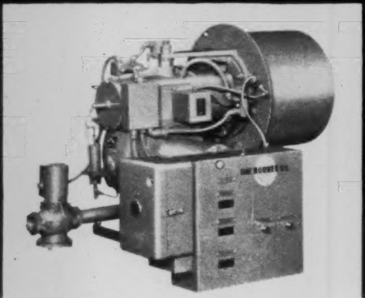
CUT
FUEL COSTS

CUT
ERRATIC PERFORMANCE

CUT DOWN-TIME



Ray Forced Draft Burner



Completely packaged Ray Forced Draft Burner

New Ray Forced Draft burners are available two ways to meet your needs and budget. Burner alone, or as a completely packaged combustion unit. Both offer all these exclusive performance features:

**FAST INSTALLATION**—Completely contained wiring is expertly done at the Ray factory. Field connecting is limited to a minimum with only simple external fuel and electrical connections to be made.

**AMAZING FUEL ECONOMY**—Ray is the only burner offering full modulation for both gas and oil. Ends step-firing and starting with a puff. With full modulation, burner closely follows load demand, maintaining steam or hot water capacity at all times, with resultant efficiency and economy.

**SMOOTH PERFORMANCE**—Smooth low to high fire transition is supplied by the Ray MODUFIRE System, along with guaranteed low-fire start. Burner gradually increases from low flame to high, then instantly drops back to low when boiler demands are met.

**NO SMOKE, NO STACK**—Clean burning from the start. Forced Draft design eliminates the need for an unsightly stack.

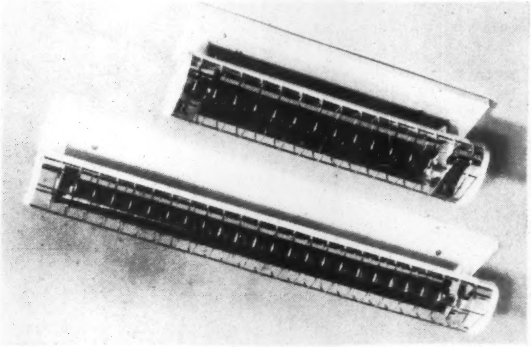
**FIT ANY BOILER TYPE**—These fully automatic units are available in three sizes to fit any type boiler and have maximum capacities ranging from 7 to 30 gallons per hour.

**BURNS HEAVY OIL**—Models of this burner are available to burn gas and all grades of fuel oil, including #5 heavy oil.

*Local factory-trained service in principal cities*

RAY SINCE 1872 **BURNER COMPANY**
1301 San Jose Avenue, San Francisco, California
629 Grove Street, Jersey City, New Jersey

6577



**Radiant Heater . . .**

. . . for spot heating is available in 10 models, three sizes of 19½, 33, and 39 in. lengths, features semi-parabolic shaped reflectors and special end reflectors for optimum coverage, fused-quartz element; ceiling and wall-mounted models plus portable wall-hanging type may be attached directly to conduit box in existing electrical system; three lengths are available in 500 or 750 watt, 1000, 1200, and 1450 watt, and 2000 watt models, respectively—*Apextro Products Co., 1821 N. Eastlake Ave., Los Angeles 31, Calif.*

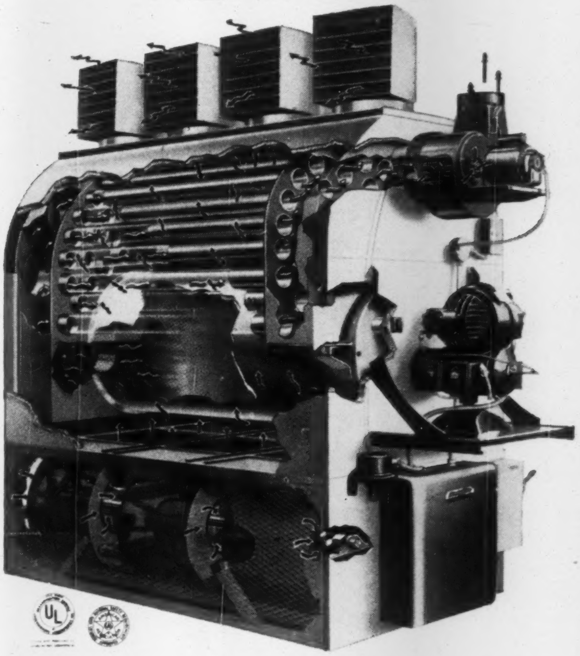
**Descaler . . .**

. . . for acid cleaning of boilers, air conditioners, heaters, evaporators, heat exchangers, etc., is made with sulfamic acid and inhibitors that allow acid to clean and dissolve scale without corrosion or damage to metal; dry crystalline material cannot splash, is non-irritating, soluble in water—*Dearborn Chemical Co., Merchandise Mart Plaza, Chicago 54, Ill.*

**Pressure-Temperature Recorder . . .**

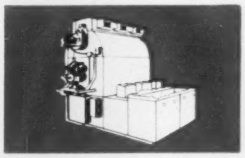
. . . electronic potentiometer type, uses constant voltage power for standardization to record one or more points of pressure and up to 23 temperature points; standard temperature and pressure ranges are 0 to 800 F and 0 to 10,000 psi, with other ranges available; bulletin "F-9789" avaliable upon request — *Wheelco Instruments Div., Barber-Coleman Co., Rockford, Ill.*

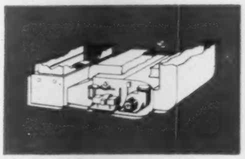
MAMMOTH
Commercial-Aire
HEATERS

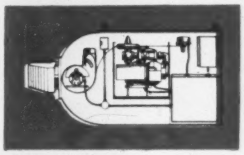


DIRECT-FIRED
Space Heaters
300,000 BTU's TO 2,000,000 BTU's

Provides industry with lowest cost heating. Primary cylindrical stainless steel combustion chamber, secondary heat-extracting tubes, consistent rate of combustion gas flow provides high efficiency, utilizing 80% of available heat of fuel. Highly adaptable to desired mounting arrangements. Features low first cost, easy maintenance, complete accessibility to all service points. Completely equipped and wired with controls for economical installation.


Series "FD"
Upright for duct distribution

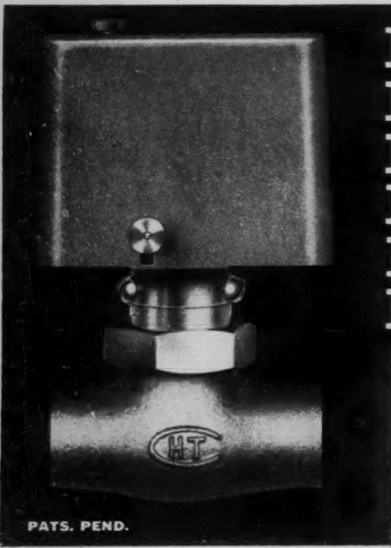

Series "HD"
Horizontally for duct distribution.


Series "H"
Horizontally suspended.

Series "U"
Inverted suspended.

MAMMOTH FURNACE CO.
6425 Cambridge St. • Minneapolis, Minn.
Please send Commercial-Aire Bulletin #C-357 and full details.

NAME ____________
ADDRESS ____________
CITY ______ ZONE ____ STATE ______



PACKLESS
PACKLESS
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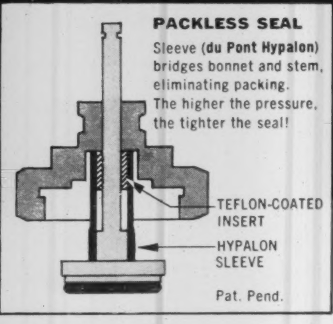
PACKLESS
PACKLESS
PACKLESS



**PACKLESS SEAL**
Sleeve (**du Pont Hypalon**) bridges bonnet and stem, eliminating packing. The higher the pressure, the tighter the seal!

**ZONVALVE®**

**the zone control valve constructed to last!**

Engineers and heating men know—it's *construction* that tells the story!

Zonvalve's packless design (Hypalon sleeve and Teflon-coated stem) means no friction—no wear—no adjustments. Zonvalve *can't* leak!

A heavy-duty motor powers Zonvalve. Pinion, spur gear and cam assembly relieves motor strain, guarantees long operating life.

Zonvalve's globe-type construction insures 100% shut-off, providing positive temperature controls with no heat waste through "seepage."

*Those are the unique construction features behind Zonvalve's unconditional written five-year guarantee.*

Zonvalve is easy to install, and operates with equal efficiency mounted in any position. It is made in all standard pipe and tubing sizes, straight and angle, from ½" to 1¼". Hand-size compactness permits installation in space as small as a baseboard enclosure. And, of course, wiring is low-voltage.

For positive temperature control on steam and hot water systems, for modernization or new construction—specify Zonvalve, install Zonvalve.

Write for informative Brochure P-9.

ZONVALVE

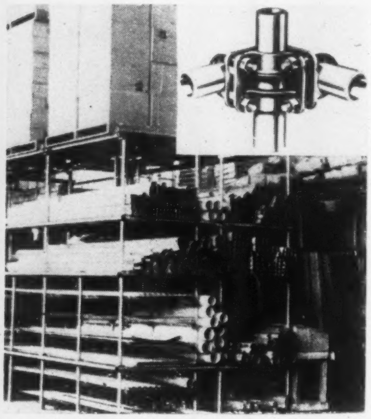
**Zonvalve's Trade-Mark is your guarantee of positive zone control. Accept no substitute!**

**HEAT-TIMER CORP.** 657 BROADWAY, NEW YORK 12, N. Y.
MFRS. OF HEATING CONTROLS SINCE 1937

IN CANADA: HEAT-TIMER CO. · 767 WARDEN AVE., SCARBOROUGH · TORONTO, ONT.

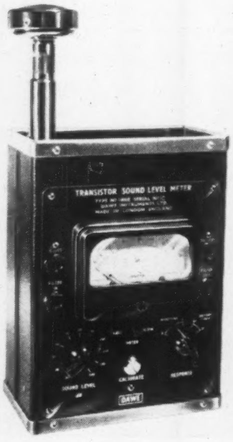
## EQUIPMENT DEVELOPMENTS

*Continued*



**Pipe Clamps . . .**

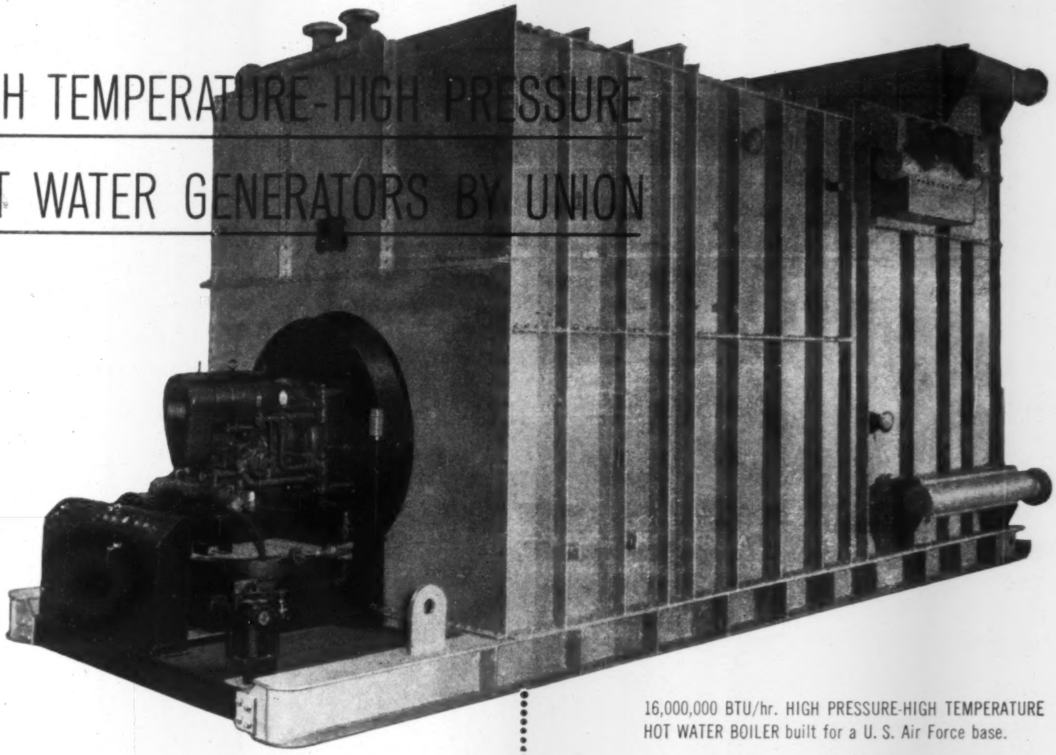
. . . for use with ordinary pipe in erection of storage racks and other fixtures of any material or shape and weight; racks thus assembled can be quickly altered to accommodate varying requirements — *Tube-Strut Corp., 2960 Marsh St., Los Angeles 39, Calif.*



**Acoustical Meter . . .**

. . . transistorized, battery operated, gives direct readings of sound-pressure levels over audio range of 24 to 140 db; with diaphragm-type microphone, 11-position attenuator calibrated in 10 db steps; powered by three dry cell batteries, unit can also operate on 115-230 v a-c, is completely self-contained in leather carrying case — *Korfund Co., Inc., 48-01F 32nd Place, Long Island City 1, N.Y.*

# HIGH TEMPERATURE-HIGH PRESSURE HOT WATER GENERATORS BY UNION



16,000,000 BTU/hr. HIGH PRESSURE-HIGH TEMPERATURE HOT WATER BOILER built for a U. S. Air Force base.

## SHOP ASSEMBLED UNITS INSTALLED WITHOUT COSTLY FIELD BALANCING

Right from the start, you can save with a Union shop assembled HTHP Hot Water Generator. With all of its circuits of the same hydraulic length, time consuming field balancing can be eliminated. Most units do not require orifices or any other mechanical adjustments to equalize flow at the time of installation.

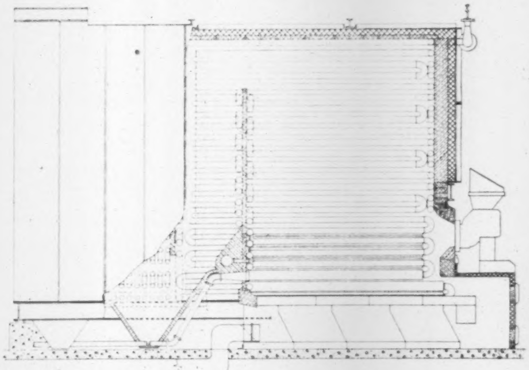
High water velocities (above 5 ft./sec.) and liberally proportioned, water cooled furnaces eliminate localized overheating. As there are no multi-tube circuits in the radiant section, recirculation within a circuit is impossible, thereby eliminating vapor binding or stagnant flow areas.

Liquid and gas flow run counter to each other. With the liquid inlet positioned at the top of the convection section, the lowest temperature liquid is served by the lowest temperature gas. As a result, generator efficiency is improved and the risk of thermal shock minimized.

Standard units (both shop assembled and field erected) can be modified to meet a wide range of job requirements. They can be arranged for firing with most commercial fuels as well as waste fuels in liquid, gaseous or solid form.

For specific information, outline your requirements to a Union representative or contact Union Iron Works.

UNION IRON WORKS • ERIE, PENNSYLVANIA



31,000,000 BTU/hr. FORCED CIRCULATION, HIGH PRESSURE-HIGH TEMPERATURE HOT WATER BOILER. Equipped for firing by an oscillating grate spreader stoker with fly ash reinjection. Fully factory-assembled for shipment.

**UNION**

water tube steam generators and allied equipment

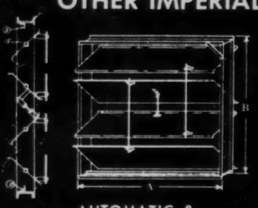
FIRE TRAPPED
before it spreads...
WHY?
FIRE DAMPER RATING 1-1/2 HOURS
Imperial DAMPER CO. NEW YORK N.Y.

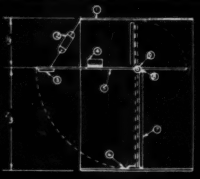
MODEL
VWNYT-1

| FEATURES | U.L. 1½ HOUR TESTS* | U.L. FACTORY INSPECTIONS | APPROVAL BY BOARD OF STANDARDS & APPEALS, N.Y.C. |
|---|---|---|---|
| Competitor X | NO | NO | NO |
| Competitor Y | NO | NO | NO |
| Competitor Z | NO | NO | NO |
| IMPERIAL MODEL VWNYT-1 | YES | YES | YES |

A Multi-Blade Fire Damper now produced under the factory inspection and label service of the Underwriters Laboratories Incorporated. *SPECIFY* IMPERIAL #VWNYT-1 FIRE DAMPERS.

OTHER IMPERIAL PRODUCTS INCLUDE...


AUTOMATIC & VOLUME DAMPERS

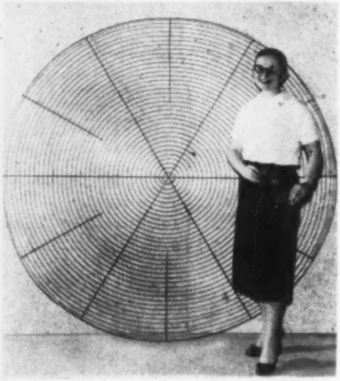

N.B.F.U. SERIES #90-A HORIZONTAL, VERTICAL OR ROUND DUCT

EXTRUDED ALUMINUM, STATIONARY & ADJUSTABLE LOUVERS

Manufacturers of Mixing Dampers, Back Draft Dampers, Shutters, Stationary and Adjustable Formed and Extruded Louvers. Send for our informative brochure. Representatives in principal cities.

IMPERIAL DAMPER COMPANY
664 EDGECOMBE AVENUE
NEW YORK 32, N. Y.
LOrraine 8 9100

## EQUIPMENT DEVELOPMENTS
*Continued*

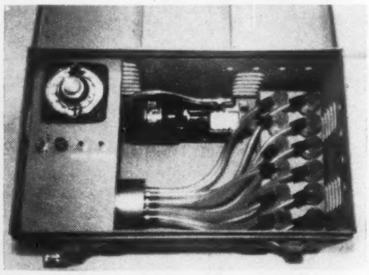


**Fan Guards . . .**

. . . wire, in sizes up to 73 in. in diameter, of welded construction, with concentric rings or spirals; variety of finishes available, including zinc, cadmium, nickel, chrome, and brass — *E. H. Titchener & Co., 57 Clinton St., Binghamton, N.Y.*

**Extension Scaffold . . .**

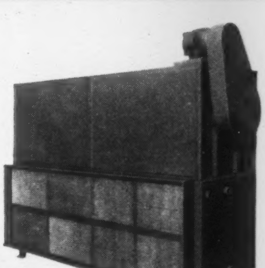
. . . extends from 6 ft. 10 in. up to 26 ft. is hand or electrically operated, furnished assembled with swivel casters on four supporting legs, has platform with safety rails, leg-type extensions for stability; of steel construction — *Atlas Industrial Corp., 849 39th St., Brooklyn 32, N.Y.*



**Air Sampler . . .**

. . . sequential type, for collection of air samples for gas determination or dust counting, consists of vacuum pump connected to 12-position valve; timer switches valve position automatically in sequence to collect air for preset periods over dial-adjusted interval; positive displacement rotary pumps available for 17 liter per minute, 1.5 or 3 cfm capacity; unit may be used with filter holders, charcoal, or refrigerated traps — *Gelman Instrument Co., Box 86, Chelsea, Mich.*

FIRST NATIONAL BANK



Thermal
Vertical Central
Plant

First National Bank, Fort Myers, Florida

Corpus Christi State National Bank, Corpus Christi, Texas

CORPUS CHRISTI STATE NATIONAL BANK

# *Satisfaction* with THERMAL that can't be discounted

## *Numerous Bank Buildings Depend on Thermal for Comfort*

As the reputation for quality and dependability of Thermal air conditioning and ventilating equipment becomes known, more and more banks, as well as all other types of buildings, are using Thermal.

This is equipment with quality to give satisfaction and long life. Design features combine ready accessibility of internal components with rugged construction.

For further details on air conditioning and ventilating equipment you can specify with confidence, write for complete catalog and names of nationally known concerns using Thermal. The Thermal line includes central and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils, and air-cooled condensers.

### Here are **some** of the banks using Thermal equipment:

East Lake Branch of Birmingham Trust National Bank, Birmingham, Ala.
Commercial Bank, Andalusia, Ala.
Commercial National Bank, Daytona Beach, Fla.
First National Bank, Ft. Lauderdale, Fla.
Dade National Bank, Miami, Florida
Florida National Bank at Brent, Pensacola, Fla.
First Federal Savings & Loan Bldg., Hattiesburg, Miss.
East Central Branch, Bank of New Mexico, Albuquerque, New Mexico
Bank of Broken Arrow, Broken Arrow, Oklahoma
First National Bank, Muskogee, Oklahoma
First National Bank, Abilene, Texas
First Savings & Loan Bldg., Corpus Christi, Texas
Austin Savings & Loan Co., Austin, Texas
North Austin State Bank, Austin, Texas
Security State Bank, Beaumont, Texas
American National Bank, Beaumont, Texas
Farm-Home Savings & Loan Bldg., Ft. Worth, Texas
Raymondville State Bank, Raymondville, Texas
First National Bank, Rockport, Texas
Bellaire State Bank, Bellaire, Texas
Lockhart Savings & Loan Bldg., Lockhart, Texas
First National Bank, Giddings, Texas
Grove State Bank, Dallas, Texas
San Jacinto State Bank, Houston, Texas
First National Bank, Refugio, Texas
Tyler Bank & Trust Co., Tyler, Texas

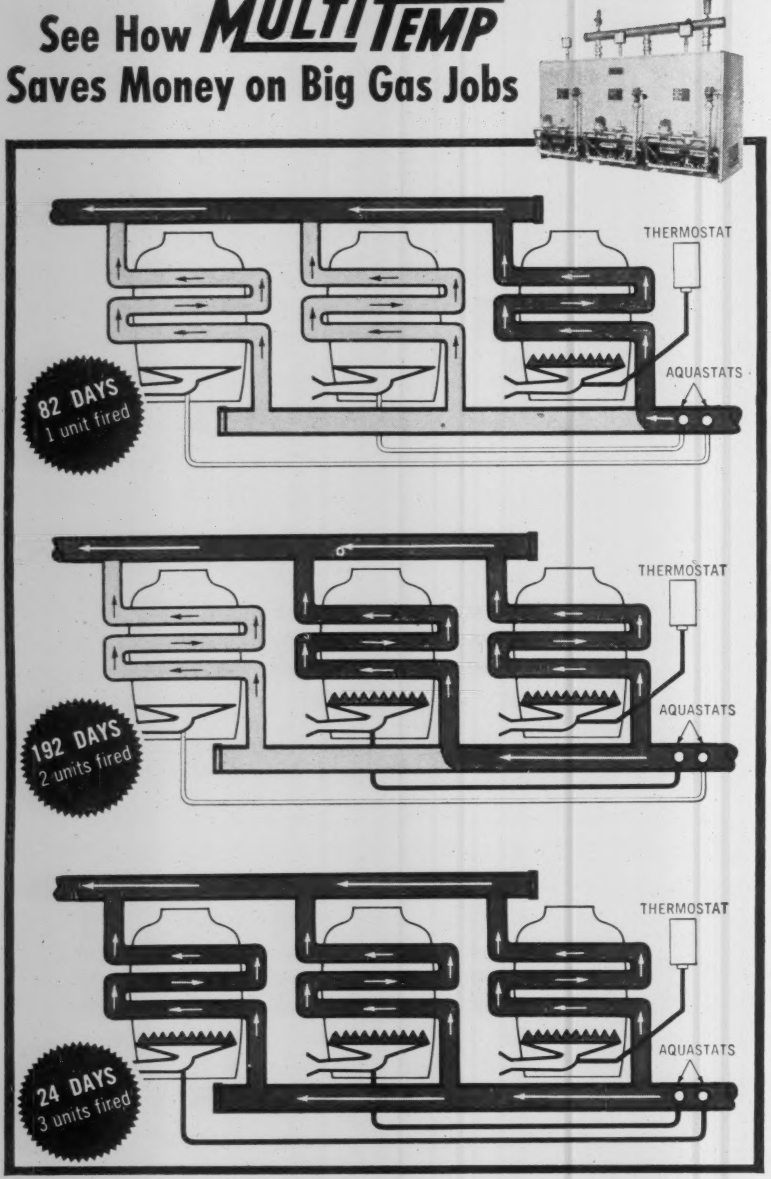
Quality Products Since 1945

**THERMAL ENGINEERING CORPORATION**

2605 W. DALLAS • P. O. BOX 13254
HOUSTON 19, TEXAS

***AGENTS IN PRINCIPAL CITIES***

See How MULTI TEMP Saves Money on Big Gas Jobs



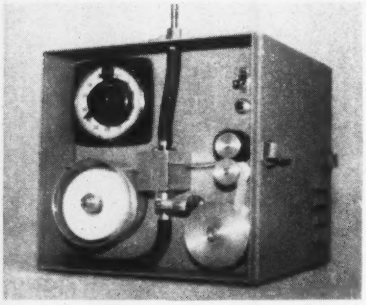
CUTS SHORT CYCLING, FUEL WASTE, INSTALLATION COSTS

Diagram shows how cast iron MULTI-TEMP Hot Water Heating Plants automatically adjust capacity to load — save fuel dollars! Sensing elements in return water header call in additional combustion units, one-by-one, as temperatures drop. The load distribution shown is typical of our northeastern region. Note: full capacity was required during only 3% of heating season, and a single unit could meet demand for over 25% of season. Set-up time is saved too — batteries do not require field rigging or joining of sections — come factory assembled with controls. Maintenance is easy on individual units without service interruptions. Capacities up to 3,600,000 BTU/hr., rated at 100# ASME working pressure. For space heating and volume water heating. *Write for catalog HY-F107 today!*

HYDROTHERM INC

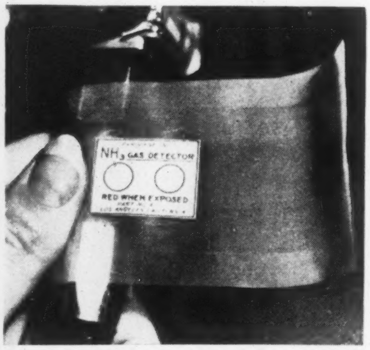
DEPT. 13-AC, NORTHVALE, NEW JERSEY

FIRST IN HYDRONIC GAS HEAT



**Air Sampler . . .**

. . . collects dust samples on paper tape which advances periodically to preserve continuing record; operates automatically on regular preset cycle with centrifugal vacuum pump at approx. 14 liters of air per minute; accessories include "paper densitometer" for dust or aerosol measurement, optical evaluator to determine gas levels, radioactive particle counter and monitoring instruments, special sensitized tapes for toxic gas measurements — *Gelman Instrument Co., Box 86, Chelsea, Mich.*



**Leak Detector . . .**

. . . flexible adhesive-backed tape bears indicators which turn contrasting color upon exposure to a specific gas or liquid, is designed in "wrap-around" style for system connections or in flat style for surface mounted indication of random leaks; available for detection of anhydrous ammonia, chlorine, hydrogen, hydraulic fluids, acid fumes, others, will detect leaks as small as 1/100 cc per hour — *Pyrodyne, Inc., 11973 San Vincente Blvd., Los Angeles 49, Calif.*

# The First National City Bank of New York

## 1,500,000 Square Feet of Gross Floor Space

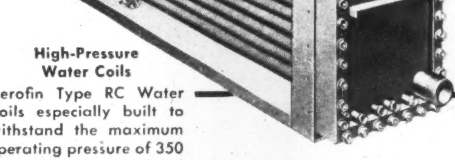
**Carson & Lundin and Kahn & Jacobs**
Associated Architects

**Meyer, Strong & Jones**
Mechanical Engineers

**George A. Fuller**
General Contractor

**Raisler Corporation**
Air-Conditioning Contractor

## AEROFIN INSTALLED



**High-Pressure Water Coils**
Aerofin Type RC Water Coils especially built to withstand the maximum operating pressure of 350 psi in the First National City Bank's new building.

Modern smooth-fin design of Aerofin coils permits ample heat-exchange capacity in limited space—permits the use of high air velocities without turbulence or excessive resistance.

Aerofin performance date are laboratory and field proved. You can specify Aerofin coils at full published ratings.

## AEROFIN CORPORATION

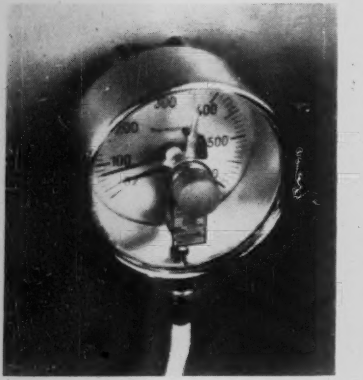
101 Greenway Ave., Syracuse 3, N.Y.

*Aerofin is sold only by manufacturers of fan system apparatus. List on request.*

ENGINEERING OFFICES IN PRINCIPAL CITIES

## EQUIPMENT DEVELOPMENTS

*Continued*



### Industrial Thermometer . .

. . .in three styles for temperature measurement only, or with maximum reset hand feature, or with electric contactor to permit "on-off" temperature control with electric resistance or induction heating; in temperature ranges from −60 to 700 F. units attach magnetically to equipment, are of bi-metal, dial, design — *Industrial Service Co., 2 Richmond St., Providence 3, R.I.*

### Motor Control Centers . . .

. . .in two types of different cubicle size: MC-5 provides up to five size 1 control cells in cabinet 20 in. wide and 90 in. high; type MC-10 contains 10 cells in 25 in. wide cabinet; each control cell houses reversing, non-reversing, 2-speed, part-winding, or reduced voltage starter in NEMA size 1 through 5 combined with fused or unfused disconnect switch or circuit breaker; lighting panels, transformers, meters, pilot devices also available; individual control units are plug-in type, cabinets supplied with NEMA type A, B, or C wiring, class 1 or 2 — *The Arrow-Hart & Hegeman Electric Co., Industrial Control Div., 103 Hawthorn St., Hartford 6, Conn.*

### Fastener Gun . . .

. . .powder actuated, for fasteners up to 3-5/16 in. overall length; can be operated with two pre-loaded cylinders, each containing eight shots, for total of 16 shots per minute; features full interchangeability of all parts for ease in servicing — *The Columbiamatic "8" Corp., Syracuse 1, N.Y.*

SONALARM
TYPE 160 SER
H.H. SCOTT, INC.
ALARM
ON
OFF
POWER
HOLD
RESET
SENSITIVITY
MONITOR

### Sonic Alarm . . .

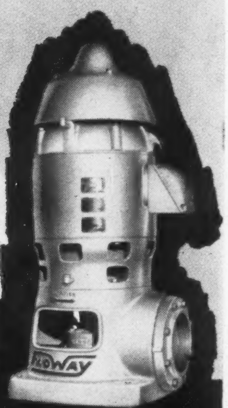
. . .operates relay contacts at preset sound or vibration level, for process or machine monitoring and control, other applications; standard model operates at 70 to 100 db pressure level, with db differential; with electronic delay for prevention of single impact trips, and audio output jack for earphone or power amplifier—*H. H. Scott, Inc., Instrument Div., 111 Powder Mill Rd., Naynard, Mass.*

VERTICAL TURBINE PUMPS

FLOWAY
formerly SMITHway

HOW FAST?

When the job engineer has completed his calculations he wants to be certain that the pump he buys will deliver the volume of liquid at the rate of flow needed to accomplish the job. FloWay designers are old hands at meeting critical requirements, not only in pumping capacity but also in type of construction to handle successfully the specific fluid whether it is hot or cold, corrosive or non-corrosive, volatile or non-volatile. FloWay serves industry in all its pumping needs. Send for Bulletin No. 14.



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Metarie, Louisiana
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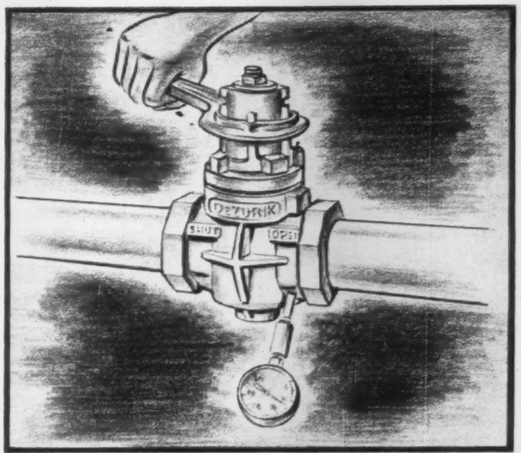
Pump & Power Engineering Co.
Seattle, Washington
Pacific Pumping Company

FLOWAY Pumps

MANUFACTURED BY
FIESE & FIRSTENBERGER MFG., Inc.
2494 Railroad Ave. Fresno, Calif.

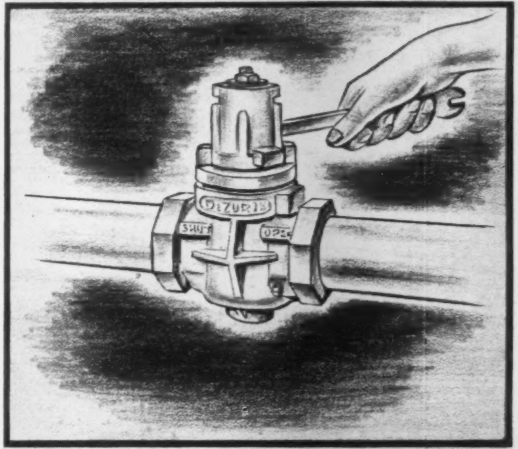
# BALANCE IT....

DeZurik Balancing Valves are drilled and tapped for a pressure gage, eliminating expensive drilling and tapping of the pipe. The excellent throttling characteristic of DeZurik Valves assures fine control — even when the valve is almost closed. And the removable handle prevents tampering with the balanced valve.



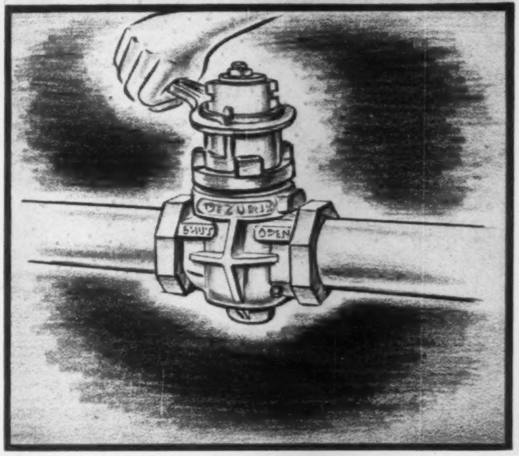
# SET THE STOP RING....

Once the system is balanced, the pressure gage may be removed and a plug inserted; the fitting is always accessible should it be required. The adjustable Stop Ring is rotated to bring the Open Position Stop against the Stop Lug, and the clamping screw is tightened. The balanced position is now positively identified!



# NOW..the valve can be closed - dead tight - and opened again - EXACTLY!

The balancing valves may be closed — drip tight — for periodic maintenance or repair, and opened again to their proper balanced positions exactly . . . positively . . . precisely! No need to remember dial settings . . . . no need to re-balance the system!



*Get more information from the DeZurik representative near you, or write for details.*

And there are more advantages with DeZurik Balancing Valves. They can be installed in limited-access areas without the bother of constant maintenance. And their rotary stem seal *will not leak!*

DZ
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CORPORATION
SARTELL, MINNESOTA

**Farr Manual Roll-Kleens Will Handle 213,400 Cubic Feet of Air Every Minute In New Lee Tower**

The newest, tallest office building in Southern California—Los Angeles' Lee Tower—will depend on Farr Manual Roll-Kleens to clean 213,400 cfm more economically than any other type of renewable roll filter system. Farr Manual Roll-Kleens were specified because: ■ They have the same filtering efficiency as automatic types—at much lower cost. ■ They are delivered in modular kits for easy job-site assembly. ■ Over 100 sizes are available to meet any design need. For full information call your local Farr Representative, or write direct to Farr Company.

**FARR**
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**Lee Tower, Los Angeles, Calif.**
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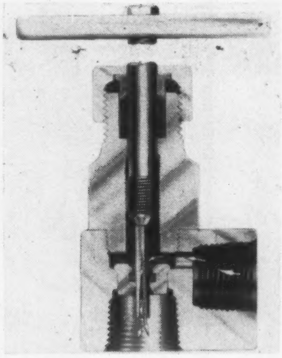
Air Conditioning Contractor
**Air Conditioning Company**

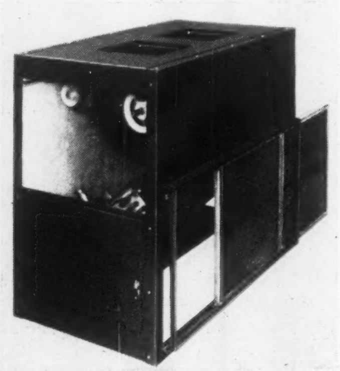
## EQUIPMENT DEVELOPMENTS

*Continued*



**Control Valve . . .**

. . .for throttling of ultra-small amounts of liquid or gas will provide flow coefficient of as low as 0.003 to zero over a linear stem travel of ⅝ in., at 5000 psi will throttle fluid from 5 gpm to 3 ccpm or down to 10 drops per hr at lower pressures; pressure ratings are to 10,000 psi, constructed of carbon steel, stainless steel, or bronze, with choice of seals; also available in air diaphragm actuated model — *General-American Valve Co., Corona del Mar, Calif.*



**Air Conditioner . . .**

. . .for small commercial applications, with self contained evaporator coil, centrifugal blowers, for connection to remote 3, 4, or 5 hp compressor-condensing unit is available in three sizes for 34,800 to 56,600 Btu per hr cooling capacity; can be installed for horizontal or vertical discharge, end, bottom, or side air intake, duct connected or with plenum grilles; filter frame is movable for bottom or side air intake applications — *C. A. Olsen Mfg. Co., Elyria, O.*

# WHAT HAPPENS WHEN A NATION SPENDS MORE ON GAMBLING THAN IT SPENDS FOR HIGHER EDUCATION?

If you can find any Romans around, ask them. They lived pretty high on the hog in their day. That is, until some serious-minded neighbors from up North moved in. The rest is ancient history.

*You'd think their fate would have taught us a lesson.*

Yet today we Americans spend twenty billion dollars a year for legalized gambling, while we spend a niggardly four-and-a-half billion for higher education. Think of it! Over four times as much! We also spend six-and-a-half billion dollars a year for tobacco, nine billion dollars for alcoholic beverages, and billions more on other non-essentials.

*Can't we read the handwriting on the wall?*

Our very survival depends on the ability of our colleges and universities to continue to turn out thinking men and women. Yet today many of these fine institutions are hard put to make ends meet. Faculty salaries, generally, are so low that qualified teachers are leaving the campus in alarming numbers for better-paying jobs elsewhere.

In the face of this frightening trend, experts estimate that by 1970 college applications will have doubled.

If we are to keep our place among the leading nations of the world, we must do something about this grim situation before it is too late. The tuition usually paid by a college student covers less than half the actual cost of his education. The balance must somehow be made up by the institution. To meet this deficit even the most heavily endowed colleges and universities have to depend upon the generosity of alumni and public spirited citizens. In other words, they depend upon *you.*

For the sake of our country and our children, won't you do your part? Support the college of your choice *today.* Help it to prepare to meet the challenge of tomorrow. The rewards will be greater than you think.

---

It's important for you to know what the impending college crisis means to you. Write for a free booklet to HIGHER EDUCATION, Box 36, Times Square Station, New York 36, New York.

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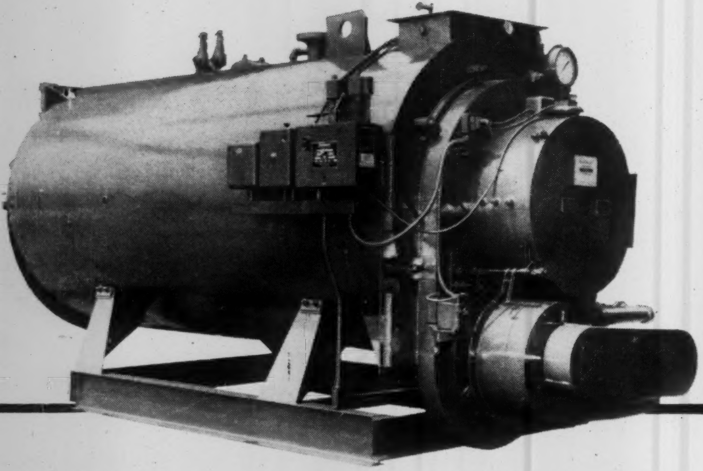
2-PASS DESIGN...



WHY THIS 2-PASS AUTOMATIC BOILER CAN GIVE YOU LOWER OPERATING AND MAINTENANCE COSTS...

In the simplified, compact design of Continental 2-Pass Automatic Boilers, you get the most practical and economical approach to heat transfer available in packaged boilers today.

HERE'S JUST ONE IMPORTANT DIFFERENCE:

Continental's 2-Pass design eliminates the need for refractory baffles and brickwork. There is *no* danger of hot gases short-circuiting direct to the stack. You eliminate costly maintenance problems and your boiler operates with low stack temperature always.

The cost-saving performance of these compact boilers is today recognized by industrial concerns and institutions of all types. All the facts on the Continental are presented concisely in a new bulletin that's yours for the asking. Write today for Bulletin BE-400.

- 15 to 600 HP Steam Boilers—to 250 PSI
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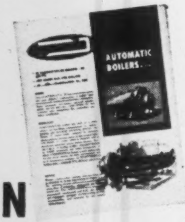
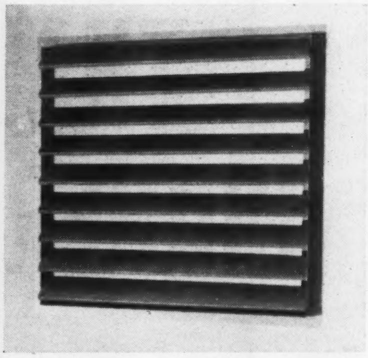


CONTINENTAL BOILER DIVISION
BOILER ENGINEERING & SUPPLY COMPANY, INC.
Phoenixville, Pennsylvania

## EQUIPMENT DEVELOPMENTS

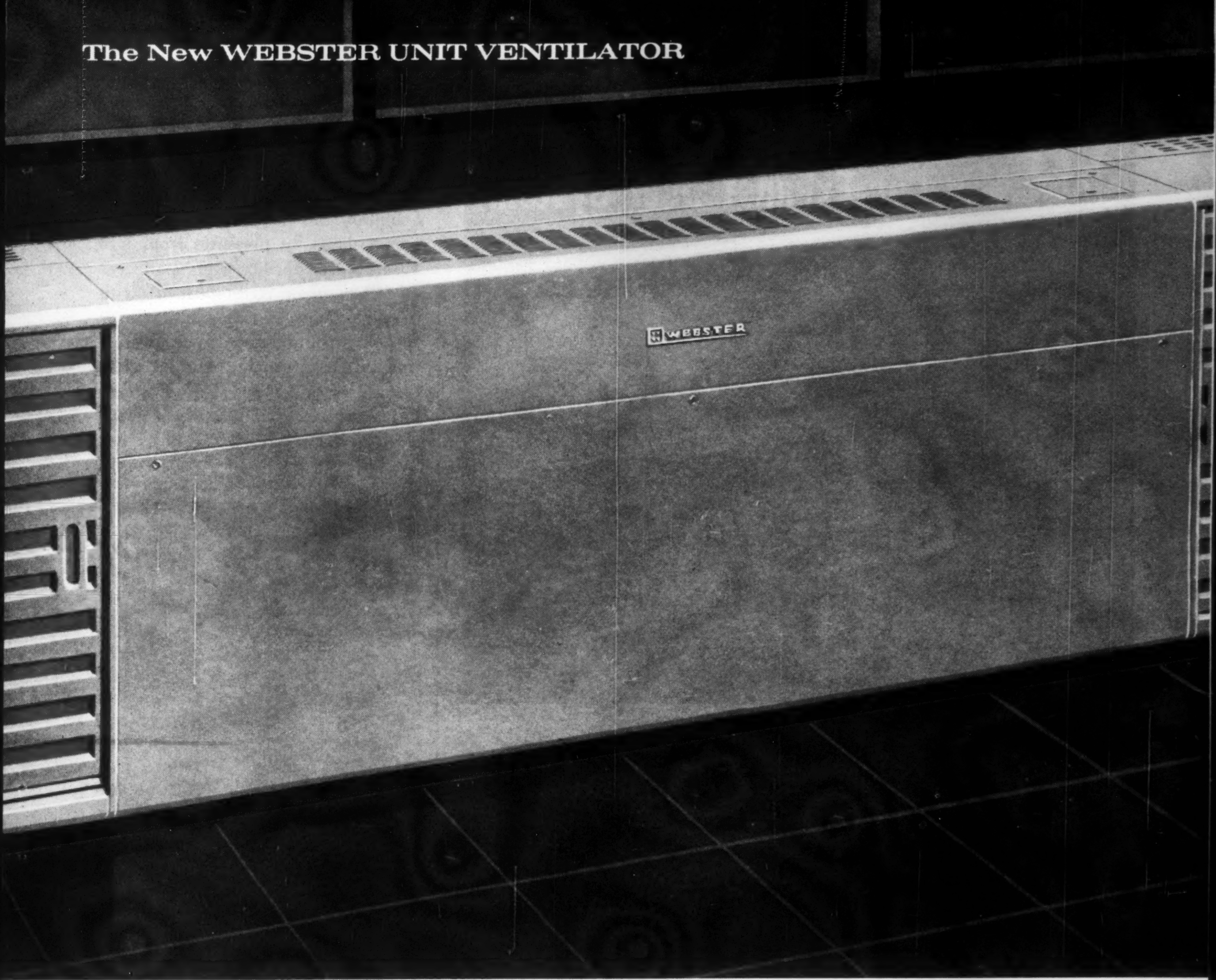
*Continued*

**Temperature Control . . .**
. . .sealed and vibration resistant for use on industrial air compressors, other equipment as high level or controlling thermostat, features snap-action disc, rapid temperature response, constant contact pressure, permanent calibration; available in normally open or closed model; electrical rating is 4 amps at 32 v, temperature setting range is −40 to 300 F, withstands ambient temperature exposure from −65 to 325 F — *Therm-O-Stats, Inc., P.O. Box 303, Chartley, Mass.*



**Ventilation Shutters . . .**
. . .aluminum, for wall and ceiling installation, with counterbalanced louvers mounted on polyethylene bearings which automatically open fully for full-capacity fan operation; shutters have double rail for stability, frame is of extruded aluminum; in special sizes to fit any opening — *Whirlwind Mfg. Co.,* 3520 *Clinton Dr., Houston, Texas.*

**Fuel Oil Tank . . .**
. . .sealed, automatic unit designed as means of supplying No. 2 or lighter fuel to one or more overhead unit heaters; of aluminum construction, tank is located above heater level, utilizes mercury switch level control system to maintain tank level; fuel is delivered to heaters by gravity feed, remote pump-motor set supplies tank — *Hartell, Inc.,* 60 *York Rd., Warminster, Pa.*



# VENTILATES AS IT HEATS—OR COOLS—FOR COMPLETE CLASSROOM COMFORT CONTROL

Glass window walls, large groups of students per room, modern artificial lighting systems . . . all combine to make ventilation and cooling a *necessity* for classroom comfort. Now, the new Webster Unit Ventilator ventilates as it circulates warm or cool air at desired temperature throughout the room. A unique air blending damper *controls* the mixture of outdoor air and recirculated room air . . . assures draft-free comfort at all times. Installed with Webster "Tru-Perimeter" Walvector, the unit ventilator provides a blanket of warm air the entire length of window walls . . . prevents chilling "downdraft".

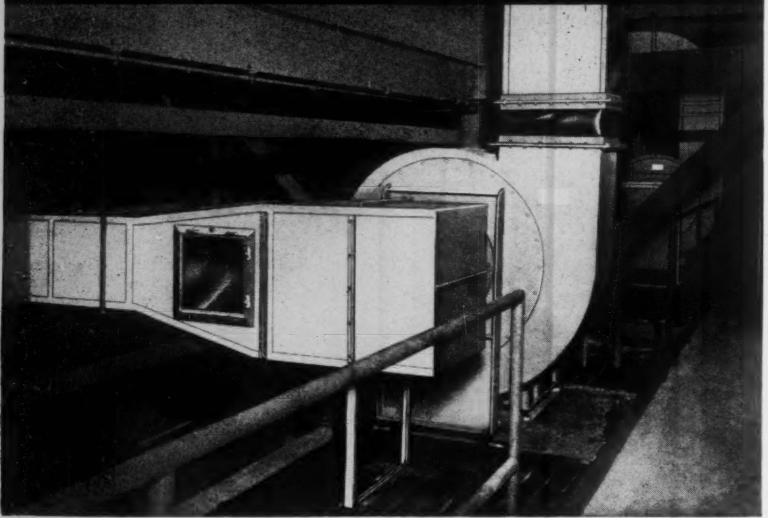
Functionally styled storage units integrate Walvector and Unit Ventilator into handsome "built-in" combination installations to fit every room. Write for detailed brochure . . . or ask your Warren Webster man about the complete line of Webster System Products for Schools.

**Webster Unit Ventilator • "Tru-Perimeter" Walvector • Webster Convector Radiators • Cabinet and Unit Heaters • Webster System Traps and Valves**

**WARREN WEBSTER & COMPANY, INC.**
HEATING • COOLING / CAMDEN 5, NEW JERSEY

problem: **Corrosive Acid Fumes**

solution: **Van-Cor Exhaust Duct System**

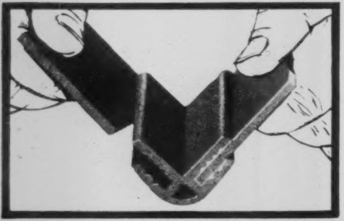


**OVER 50,000 SQ. FT. OF VAN-COR SHEET AND JOINING STRIPS** remove all acid, plating and cleaning fumes throughout the Allentown (Pa.) Works of Western Electric Co. Corrosion is stopped in its tracks because Van-Cor unplasticized PVC is resistant to scores of acids, alkalies and salts.

Although the contractor was unfamiliar with plastics fabrication, he was able to assemble the components of this system on the job site at a substantial savings over installation of prefabricated components. This savings was made possible through the use of Van-Cor joining strips.

**VAN-COR FABRICATIONS, PIPE, FITTINGS, VALVES, CONDUITS** offer *you* these advantages:

1. *Resist Corrosion of Industrial Acids & Alkalies*
2. *Light in Weight (½ that of Aluminum)*
3. *Easily Installed; High Tensile Strength; Low Flow Resistance*
4. *Readily Formed, Machined, Threaded and Welded*



Van-Cor 90° and H Joining Strips
The fast, low-cost way
to connect PVC sheet stock.

*Write for Catalog and Name of Nearest Distributor*

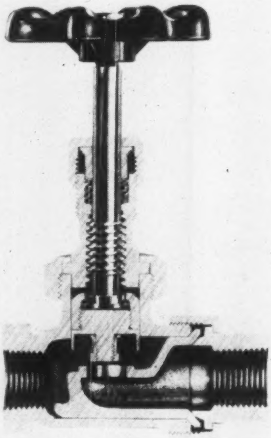
INDUSTRIAL DIVISION OF . . .
**COLONIAL PLASTICS MFG. CO.**
Subsidiary of THE VAN DORN IRON WORKS CO.
2685 EAST 79TH STREET CLEVELAND 4, OHIO

## EQUIPMENT DEVELOPMENTS

*Continued*

### Gas-Electric Ignitor . . .

. . . for use with pulverized coal, gas, oil, or combination fuel burners, 1 to 5 million Btu per hr capacity, operates with gas at pressures from 1 to 15 psi; transformer and spark cut out when flame is established; with integral flame proving feature, may be used with atmospheric or pressurized furnaces, can be removed while furnace is under pressure—*Peabody Engineering Corp.*, 232 *Madison Ave., New York* 16, *N.Y.*



### Globe Valve . . .

. . . for steam, oil, water, or gas lines, of bronze construction for pressures of up to 200 psi saturated steam, temperatures to 400 F, non-shock loads up to 400 psi; features built-in ground joint union with manganese bronze nut for easy seat removal — *Flomatic Corp., Hoosick Falls, N.Y.*

### Convertible Valve . . .

. . . can be changed from manual valve to control or motor operated on-off type by replacing bonnet and set with yoke carrying required topworks; of venturi-ball design, available in $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, and $\frac{3}{4}$ in. sizes with pressure ratings of 1500 and 2500 psi; manual model standard construction is with inside screw, automatic conversion is with outside screw and yoke design — *General Kinetics Corp.*, 197 *S. Van Brunt St., Englewood, N.J.*

## MSA reports on:

# How to Select an Air Cleaner

MSA reviews here some of the factors which influence selection of air cleaners. A speaking acquaintance with these factors can save a lot of time and money. If you would like to dwell further on any of these points, please drop us a line. We believe we can be of great help in answering questions on your specific air cleaning problems.

**CLASSIFICATION OF PARTICULATE LOADS**—Let's draw a parallel. Because of the heavy dust load in a sand blast booth, you would have to select a sand blast mask instead of a dust respirator. Selection of a particulate space filter is much the same proposition. You must determine the quantitative nature of the particulate load.

For this purpose, let's briefly classify particulate loads. A light load is 0.1 to 1 grain per 1000 cu. ft. A medium load is 1 to 1000 grains per 1000 cu. ft. A heavy load is 1000 grains and up per 1000 cu. ft.

One grain per 1000 cu. ft. = 2.3 mg per cubic meter = 2.3 micrograms per liter. One milligram is equivalent to 0.015432 grains. As a comparison, the concentration of the U. S. Bureau of Mines silica dust test is approximately 22 grains per 1000 cu. ft. of air.

**CLASSIFICATION OF NORMAL LOAD RANGES**—Country air usually registers 0.2 grains/1000 CF. Small town air ranges from 0.2 to 0.4 grains/1000 CF. City residential air ranges from 0.4 to 0.8 grains/1000 CF. City industrial air ranges from 1.0 to 2.0 grains/1000 CF. And air from industrial operations weighs in at 4.0 to 8.0 grains/1000 CF. 7000 grains, incidentally, is equal to 1 lb.

**CLASSIFICATION OF PARTICULATE CLEANERS**—Your actual load condition will determine which group of particulate cleaners is of immediate interest to you.

For the heavy loads: gravity separators, cyclone separators and sonic collectors.

For the medium loads: all of the above plus bag filters, impingement type box filters, and wet collectors.

For the light loads: box filters of both types and, in addition, electrostatic precipitators.

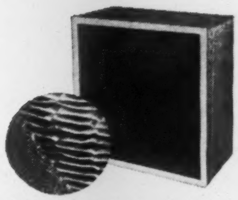
Of course, if you require ultra filtration on heavy load conditions, you should use M-S-A® UltraAire* Space Filters after the heavy duty filters.

**PHYSICAL CHARACTERISTICS OF THE PARTICULATES**—These characteristics affect the choice of filtering methods and/or design of the filtering system: Particle size, particle shape, specific gravity of particles, particle surface characteristics, packing or plugging characteristics, electrostatic charge on the particle, stability of the particle.

**PHYSICAL CHARACTERISTICS OF THE AIR STREAM**—These factors too, are worthy of investigation: Density of air, moisture in air stream, temperature of air stream, chemical and physical effect of gaseous contaminants.

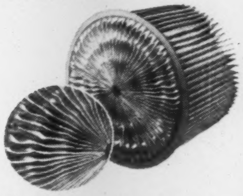
**DEGREE OF FILTERING OR CLEANLINESS REQUIRED**—We'd like to suggest here, that you give some thought to the toxicity or harmfulness of the particulate matter. Evaluate too, the need for cleanliness, product control, equipment maintenance, etc.

**ECONOMIC FACTORS**—Factors to weigh under this heading are installation costs, space requirements and operating and maintenance costs (including cost of moving air through system, replacement, etc.).



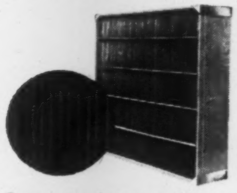
**M-S-A® UltraAire* Space Filter**

Lightweight, fire-resistant, unusually strong, and ideal for high humidity service. Individually pre-tested and proved at least 99.97% efficient in removing particles of 0.3 micron diameter.



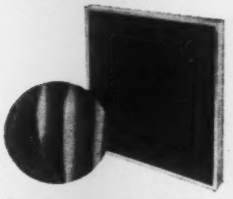
**M-S-A® Cylindrical-Type UltraAire* Space Filter**

Honeycomb-type fold without separators is admirably suited to cylindrical element construction. This shape is preferred for pressure systems and round ducts. Easy to handle. Inexpensive to ship.



**M-S-A® Dustfoe* Space Filter**

Offers the efficiency of an Electrostatic Precipitator without the high cost and without the possibility of arcing "blow-off." 85-95% certified efficiency on NBS Atmospheric Air Dust Stain Rating.



**M-S-A® Air-O-Kay* PreFilter**

Impingement type panel prefilter which can be used oiled or dry to remove lint and other large airborne particles from the atmosphere. 60-70% certified efficiency on NBS Stain Rating.

Write for illustrated technical bulletins on M-S-A Space Filters related to your particular system problem. Ask an MSA Representative for system recommendations.

*Fluid Purification Specialists for 45 Years*

**MINE SAFETY APPLIANCES COMPANY**

201 North Braddock Avenue, Pittsburgh 8, Pa.

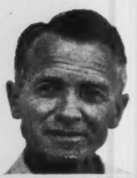
MSA*

*Trademark

Other Fluid Purification Equipment includes catalytic filters for jet aircraft cabin air; air separation plants; inert gas generators; space capsules; bomb shelters; air line filters; jet fuel and hydraulic fluid purification.

*"ENTERPRISE Burners perform to our fullest expectations —year after year"*

**Says Otto Walters, Head Custodian, Capuchino High School, San Bruno, Calif.**



## Users, Engineers, Contractors—all agree:

*"Everyone Benefits When It's an Enterprise"*

The man who's on the job with heating operations day after day has the facts. At the modern, two-level Capuchino High School facility—which includes fifty-one class rooms, heated pool, gym, theater, auditorium, cafeteria, shops and kitchen—this man is Head Custodian Otto Walters. His four Enterprise Burners have delivered smooth, trouble-free service for both class rooms and hot water needs 5 days a week for nearly eight years.

On-the-job performance such as this naturally scores big with everyone down the line—dealer, engineer, contractor and user. Check the facts—you'll learn that the men who specify and work with Enterprise have found the best burner buy!

Fit your specifications to the *right* burner model from the complete range of Enterprise Burner sizes shown here:

**HORIZONTAL ROTARY OIL BURNERS, & COMBINATION OIL & GAS BURNERS**

| INPUT | | | | OUTPUT | | |
|---|---|---|---|---|---|---|
| Burner Size | Motor HP | Oil-GPH Max | Gas CF/HR | Steam | | Radiation-Sq. Ft. Steam |
| | | | | LBS/HR | BHP | |
| AA | ½ | 4 | 600 | 464 | 13 | 1880 |
| A | ½ | 7 | 1050 | 812 | 23 | 3280 |
| C | ½ | 15 | 2250 | 1740 | 50 | 7050 |
| E | ½ | 20 | 3000 | 2320 | 67 | 9400 |
| F | ¾ | 30 | 4500 | 3480 | 100 | 14100 |
| G | 1 | 35 | 5250 | 4060 | 118 | 16400 |
| H | 1 | 50 | 7500 | 5800 | 168 | 23400 |
| H | 1½ | 60 | 9000 | 6960 | 201 | 28200 |
| J | 2 | 75 | 11250 | 8700 | 250 | 35250 |
| K | 3 | 100 | 15000 | 11600 | 336 | 46900 |
| L | 3 | 135 | 20250 | 15660 | 453 | 63400 |
| M | 5 | 200 | 30000 | 23200 | 672 | 94000 |

*The Choice of Heating Experts*

**ENTERPRISE**

**DEPENDABLE BURNERS**

ADEL DIVISION, GENERAL METALS CORP. • 1444 WASHINGTON AVE., HUNTINGTON 1, W. VA.

## EQUIPMENT DEVELOPMENTS

*Continued*

### Ventilator Curb . . .

. . . prefabricated, for roof ventilator openings from 10 × 10 in. up to 36 × 36 in., with outside top curb dimensions of 20 × 20 in. up to 52 × 52 in.; constructed of painted steel, with welded joints, base and separate corner cants reduce possible leak points and prevent tearing of roof material; glass fiber insulation installed between "double-shell" walls, top curb is of wood for easy ventilator mounting — *Swartwout Fabricators, Inc.*, 100 *E. North St., Kokomo, Ind.*

### Air Conditioners . . .

. . . for year 'round service are designed to fit in relatively small space, available in five sizes: 800, 1000, 1500, 2000, and 3000 cfm nominal capacities; offered with chilled water or direct expansion cooling coils, hot water or steam heating coils — *Thermal Engineering Corp., P.O. Box* 13254, *Houston* 19, *Tex.*

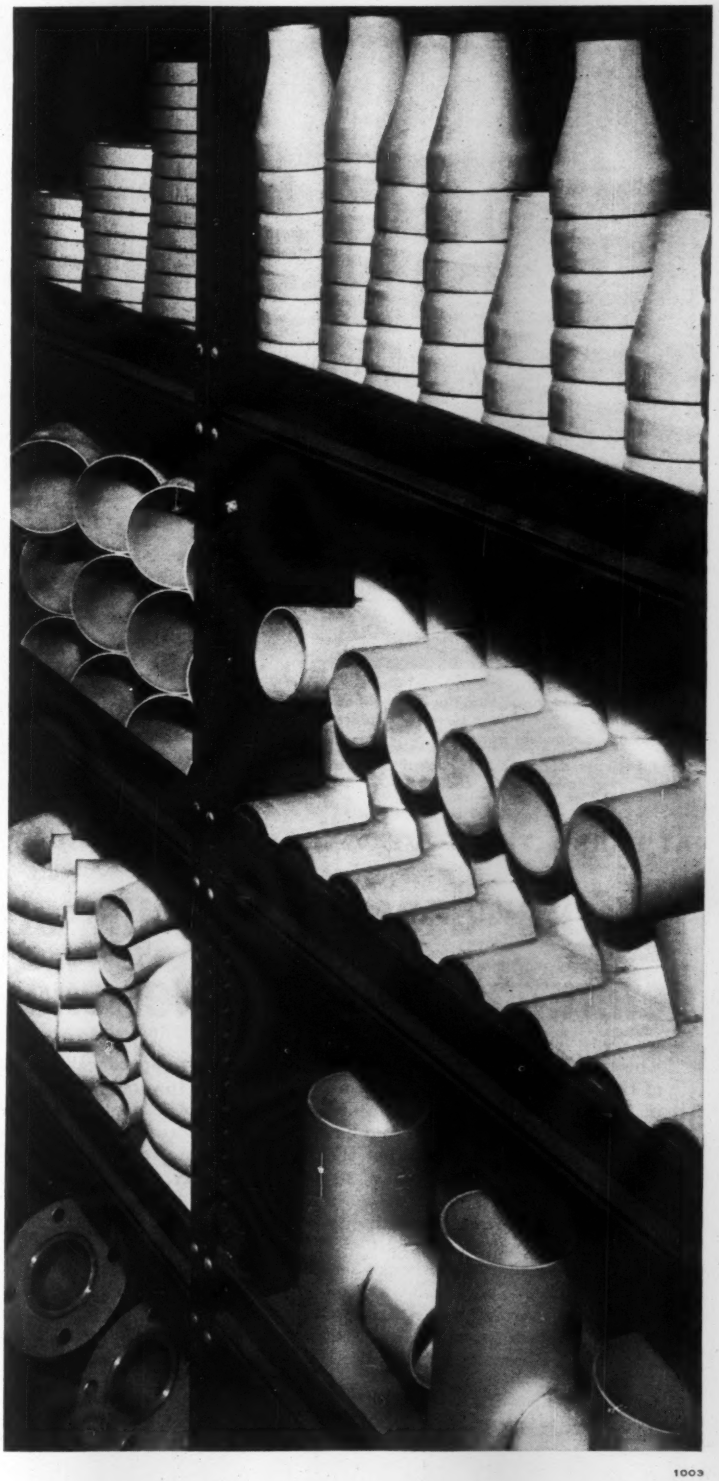
### Spot Welder . . .

. . . metal, inert gas shielded arc unit for mild steel, galvanized carbon steel, stainless, aluminum and other metal spot welding from one side only, handles 0.03 to ¼ in. thicknesses, can also be used for space, tack, and bead welding, according to manufacturer; makes approx. 20 spot welds per minute by trigger operation—*Hobart Brothers Co., Hobart Square, Troy* 1, *O.*

*THERE IS A DIFFERENCE IN PIPE FITTINGS*

*Speedline*®

# FITTINGS ARE IN STOCK NOW... COAST TO COAST



1003

It's one thing to catalog a complete line of long-tangent fittings . . . it's another to have them ready to ship to your plant—*when* you need them. Speedline engineering and manufacturing experience has "standardized" production on even the most specialized fittings . . . including eccentric reducers, reducing tees and crosses . . . making it possible to maintain extensive inventories both at the factory *and* in the field.

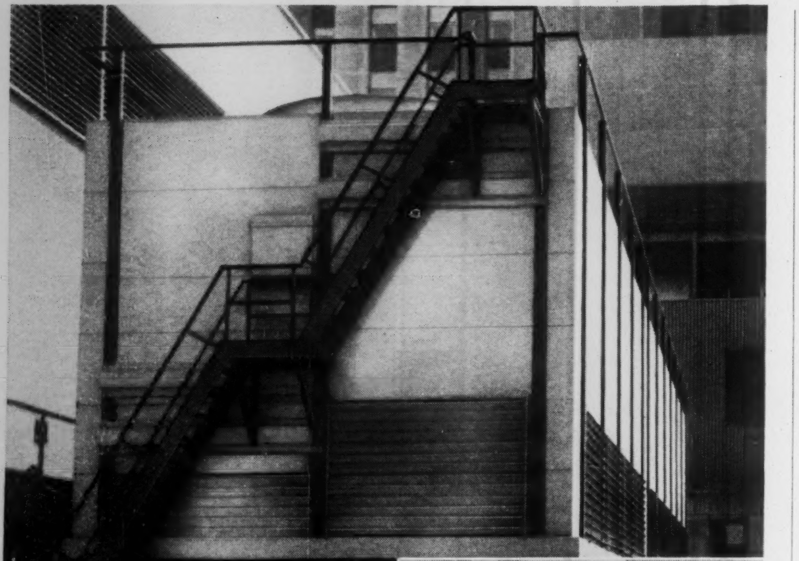
A Speedline distributor is prepared to give delivery-from-stock on stainless steel fittings . . . including Carpenter 20 . . . for every process piping requirement. He can also assure prompt service on Speedline fittings in aluminum, titanium, zirconium, Hastelloy and other special corrosion-resistant alloys.

Leading plants have proved there *is* a measurable difference with Speedline fittings . . . the only complete line of long-tangent fittings available from distributor stocks. Let a Speedline distributor prove the difference Speedline experience and ready availability can make at your plant.

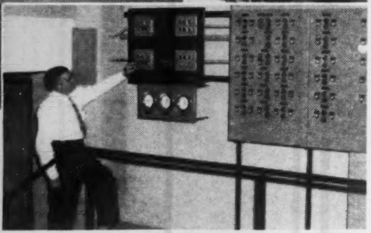
*Speedline*®

**CORROSION-RESISTANT FITTINGS**

A PRODUCT OF **HORACE T. POTTS COMPANY** • 576 E. ERIE AVENUE, PHILADELPHIA 34, PA.



5-fan Binks cooling tower. Original 2-fan unit has operated since 1951 without need for replacement of any component parts.



Chief Engineer Karl Hecht at control panel of Binks cooling tower. Tower cools 7,050 GPM.

AT HARRIS TRUST & SAVINGS BANK, CHICAGO

modular design, servicing ease determine cooling tower choice!

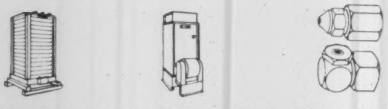
The first Binks 2-K tower, erected at the Harris Trust & Savings Bank in 1951, has required less than one day's maintenance per year and has given satisfactory service. When the bank decided to build a new 23-story building in 1959 it selected a Binks tower to retain continuity in their equipment.

Modular design of the Binks 2-K made it simple to add a 3-fan section to the original 2-fan installation. Standardized construction eliminated the need for expensive modifications.

It's easy to specify Binks standard cooling towers. Whatever your requirements . . . capacity, quietness, induced or forced draft . . . there's a Binks cooling tower that fits your needs exactly.

For complete information . . .

. . . write to the address below. Give dimensions, capacities and other specifications and performance data needed.



0800

Binks
EVERYTHING FOR
WATER COOLING

A COMPLETE LINE OF NATURAL DRAFT AND MECHANICAL DRAFT COOLING TOWERS AND INDUSTRIAL SPRAY NOZZLES

Binks Manufacturing Company
3118-38 Carroll Ave., Chicago 12, Ill.

REPRESENTATIVES IN PRINCIPAL U.S.& CANADIAN CITIES • SEE YOUR CLASSIFIED ☎ DIRECTORY

## you'll want to know

(Continued from page 44)

winch, which permits the X-ray unit to be moved up and down within a vertical frame. Heights can be adjusted from $2\frac{1}{2}$ to 6 ft above the floor.

Although the machine was equipped with a water cooling system, Mr. Singiser adapted the system to the use of low pressure air, for which outlets are located throughout the plant.

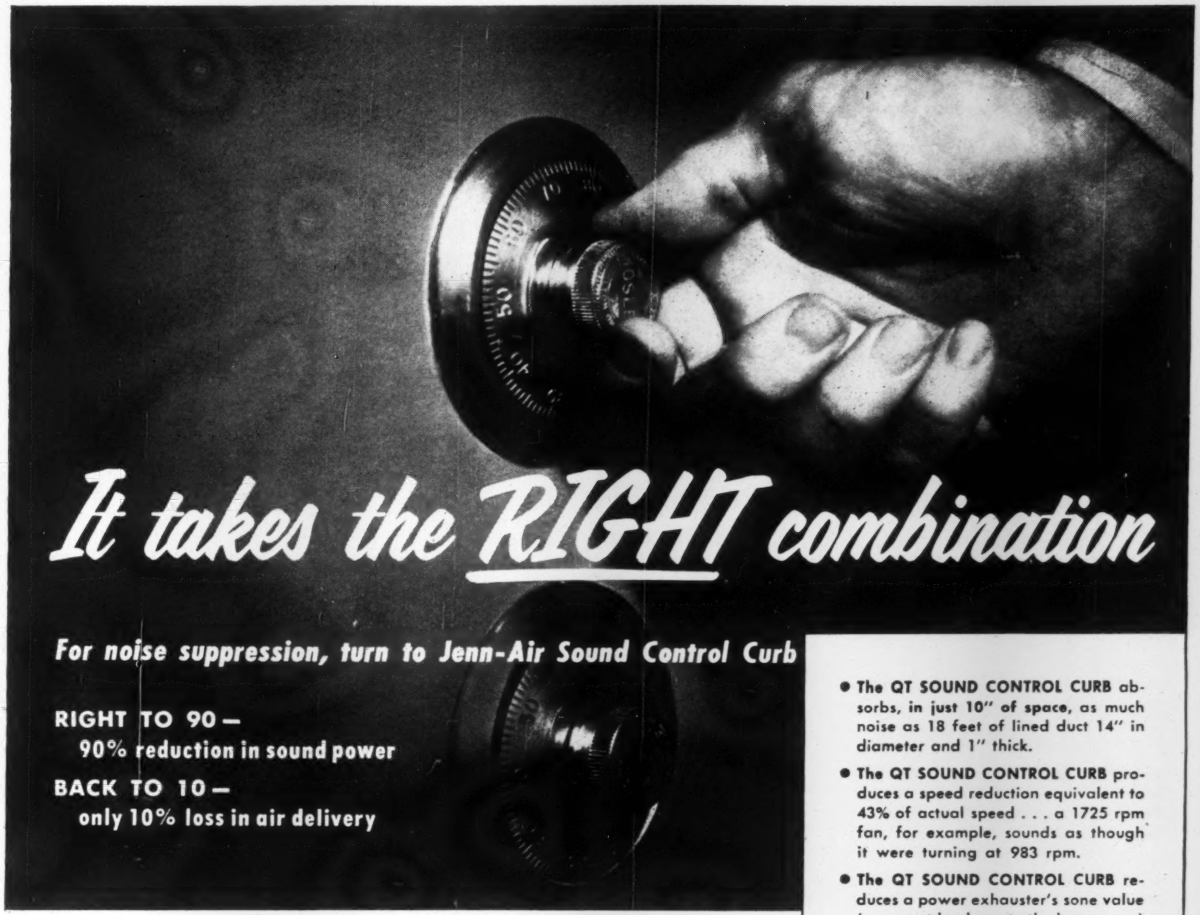
The high powered equipment allows the operators to make simultaneous exposures of seam sections up to three times as long as could be handled previously. For example, the weld seam of a $\frac{1}{4}$ in. thick pressure vessel previously was covered with film on the inside of the container, after which the exposure was made from outside. Now a similar vessel's seam is covered on the outside with film, and the picture is taken from the opposite side of the vessel, through both metal thicknesses and across the diameter of the cylinder.

Exposure time has also been cut by as much as one-half on routine work such as plate welds. X-rays of metal up to 2 in. thick can be made with the mobile equipment.

### Industrial Air Conditioning Can Pay Production Dividends

INDUSTRIAL air conditioning installations will increase in number as management discovers that greater production can be obtained through increased efficiency at an economical cost, according to Carl W. Millsom, vice president of Perfection Div., Hupp Corp.

Mr. Millsom declared that over-optimistic estimates of production increases are unnecessary and may even be harmful to the industry, in view of the fact that in some instances a $1\text{-}\frac{1}{2}$ to 3 per-



# It takes the RIGHT combination

**For noise suppression, turn to Jenn-Air Sound Control Curb**

**RIGHT TO 90 —**
**90% reduction in sound power**

**BACK TO 10 —**
**only 10% loss in air delivery**

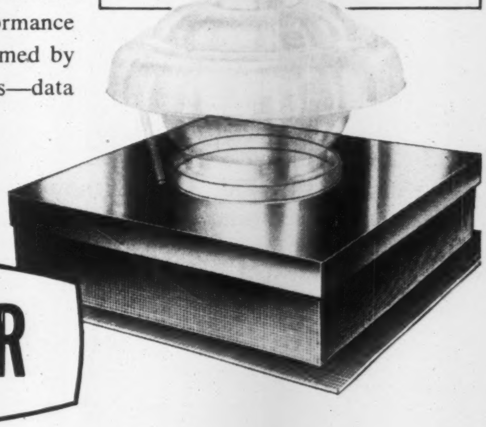
- **The QT SOUND CONTROL CURB** absorbs, in just 10" of space, as much noise as 18 feet of lined duct 14" in diameter and 1" thick.
- **The QT SOUND CONTROL CURB** produces a speed reduction equivalent to 43% of actual speed . . . a 1725 rpm fan, for example, sounds as though it were turning at 983 rpm.
- **The QT SOUND CONTROL CURB** reduces a power exhauster's sone value (apparent loudness to the human ear) by approximately two-thirds.
- **The QT SOUND CONTROL CURB** offers effective noise control in an easily-installed, self-flashing, prefabricated curb.

***Leader in functional IMAGINEERING . . .***

The "right combination" in power exhauster curbs is (1) effective noise suppression *plus* (2) high air delivery. Only *one* unit provides both! The Jenn-Air QT Sound Control Curb reduces exhauster sound power 90% with only a 10% loss in air moving capacity! This achievement is the result of unique Jenn-Air patent-protected design features.

Both "right combination" factors deserve equal consideration from the engineer. Good attenuation ratings are worthless if achieved at the expense of air delivery. By the same token, claims of unrestricted air flow probably mean that little or no attenuating ability can be expected.

Get *all the facts* before you specify . . . prove to yourself that Jenn-Air's QT Sound Control Curb represents a major breakthrough in the field of noise control for power roof ventilation. The QT curb's performance ratings (see box) are confirmed by independent laboratory tests—data available on request.



**JENN-AIR**

**JENN-AIR PRODUCTS COMPANY, INC. 1102 Stadium Drive · INDIANAPOLIS 7, INDIANA**
*Member Air Moving & Conditioning Association*

SAVE SPACE and REDUCE COSTS with AURORA® VERTICAL END-SUCTION PUMPS

Capacities to 1800 GPM
Heads to 320 Feet

This close-couple, vertical mounting design provides the extreme compactness that is so important for the many applications where space allocation is critical. Flanged suction mounting cuts piping costs by direct mounting to tank. Separate foundation arrangement is eliminated along with any alignment problems. Optional discharge arrangement permits the most simplified installation.

The many desirable features of the Horizontal End Suction Pumps are retained . . . motor and rotary assembly easily removable without disturbing the suction or discharge piping . . . low NPSH . . . smooth quiet operation. Available in vertical base mounting design as well as close coupled or flexible coupled horizontal models.

WRITE TODAY FOR BULLETIN

AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
650 LOUCKS • AURORA, ILLINOIS
LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

cent rise in production will justify the installation. He noted that the General Service Administration, landlord for all government buildings, found that savings in salaries alone would pay for air conditioning if worker output increased by 1-½ percent.

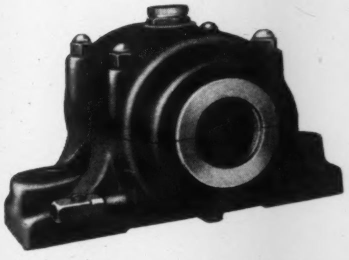
He emphasized that not all industrial areas can be cooled economically, and as a general guide suggested that the proprietor should not spend more than one-fourth of total gross wages of the workers to cool the space in which they work. He stated that successful application depends upon an accurate evaluation of the needs of the plant and of the possible systems which might be installed, and that the aim should be practical, rather than optimum, air conditioning. Thus it is unnecessary to design for a 72 degree temperature when a slightly higher temperature will result in the desired increased production, or to cool the upper reaches of a plant instead of providing cool air only to the lower, or working areas. He also noted that proper venting or isolation of heat producing machinery can result in cost cuts, and that it is important to check actual operating time of such machinery.

Mr. Millsom's remarks were made before an Interstate Power club meeting in New York City.

## *New President For Minneapolis Contracting Firm*

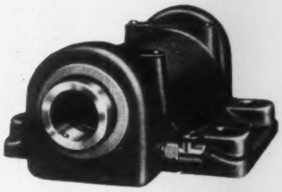
Anthony L. Cherne, formerly vice president of the nationally known mechanical contracting firm of Reuben L. Anderson-Cherne, Inc., Minneapolis, Minn., has been named as the new presi-

# QUIET



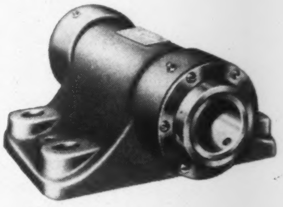
**DODGE SLEEVOIL PILLOW BLOCKS**

Exceptionally quiet in operation. Noted for superb quality. Plain and Water Cooled Types. Precision-built, ring-oiling, babbitted. Self-aligning. Can be drilled for thermostatic emergency warning. Shaft sizes from 1-7/16″ to 10″.



**DODGE BRONZE BUSHED PILLOW BLOCKS**

Designed for Arrangement No. 2 installations. Two bronze bushings of high lead content mounted in one cast iron housing. Special T-section rings for dependable lubrication. Exceptionally quiet in operation. Shaft sizes from 15/16″ to 2-3/16″.



**DODGE BALL BEARING PILLOW BLOCKS**

Designed for Arrangement No. 2 installations. Two precision single row, deep groove ball bearings in one cast iron housing. Extended inner race carries shaft. Remarkable ease of installation and maintenance. Shaft sizes from 15/16″ to 2-3/16″.

These quality bearings have been developed in close cooperation with manufacturers of fan and blower equipment — to meet the highly specialized requirements of this field.

The nation's great generating plants choose these bearings because of their extraordinary dependability—and the extreme quietness of their operation makes them top choice for air conditioning systems in hospitals, schools, theatres, auditoriums.

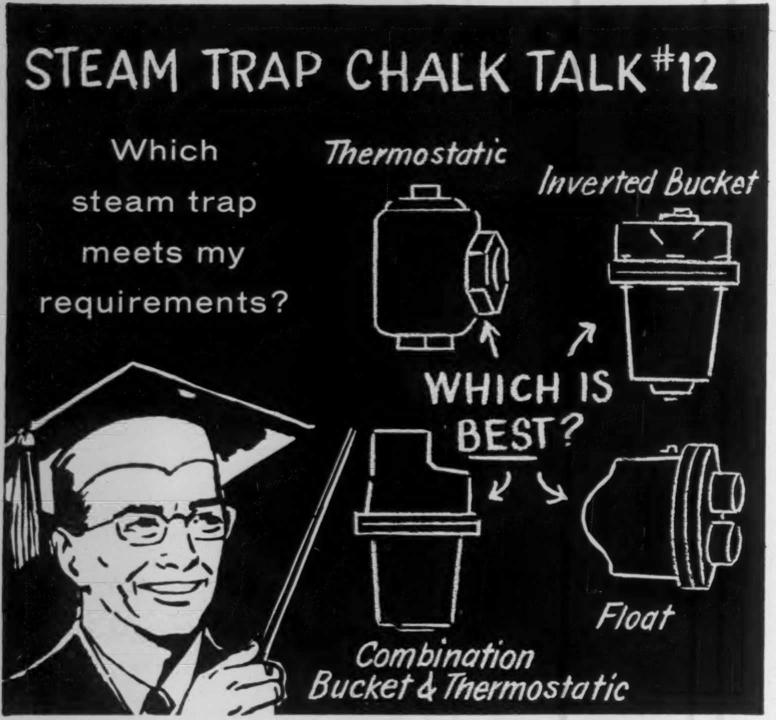
Dodge Fan and Blower Bearings are available from stock—with stock-product economy. Consult your local Dodge Distributor—or write us for technical data.

DODGE MANUFACTURING CORPORATION
1600 Union Street, Mishawaka, Indiana

**DODGE**
of Mishawaka, Ind.

**MANUFACTURER OF AMERICA'S MOST COMPLETE LINE OF MOUNTED BEARINGS**

**CALL THE TRANSMISSIONEER**—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the white pages of your telephone directory, or in the yellow pages under "Power Transmission Equipment."


STEAM TRAP CHALK TALK #12
Which steam trap meets my requirements?
Thermostatic
Inverted Bucket
WHICH IS BEST?
Float
Combination Bucket & Thermostatic

Is there an all-purpose steam trap to meet all requirements? There is no existing single purpose trap to answer all trapping problems. Instead, Anderson offers four different trap designs, each engineered for a definite type of application.

For your general purpose applications, the answer is Super-Silvertop Steam Traps. Where fast heating-up is required, Anderson Heat-Kwik Combination Open Float or Thermostatic Traps are without an equal. Ideal for outdoor, freeze-proof installations, insist on our Quik-Flex Thermostatic Steam Traps. For draining condensate from steam or moisture from air and gas equipment, Anderson continuous flow type Float Traps are unbeatable.

For the highest efficiency in traps for all purposes, make your selection from Anderson's complete line of traps. Mail coupon for our engineering catalog, "How To Select Steam Traps and Other Fluid Specialties".

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SUPER-SILVERTOP
STEAM TRAP

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*division of International Basic Economy Corporation*
**1949 West 96th Street • Cleveland 2, Ohio**

**Please send a copy of your new engineering booklet, "How to Select Steam Traps and Other Fluid Specialties".**

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Company__________
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City__________ Zone_____ State_____

**ANDERSON SUPER•SILVERTOPS**

## you'll want to know

dent of the firm. He succeeds Reuben L. Anderson, who will continue his association with the company as a consultant in the capacities of chairman of the board and chairman of the executive committee.

Mr. Cherne has been active in the contracting business for more than 25 years. He joined his present company in 1941 and was named a partner in 1946. In addition to the presidency of Anderson-Cherne, he holds the positions of director of the First Edina National Bank, secretary of Anderson-Cadillac, Inc., and secretary-treasurer of The Cherne Co., Inc., the Ironwood, Mich., firm founded by his father, A. G. Cherne.

The retiring president, who founded Reuben L. Anderson, Inc., in 1920, has announced plans to devote increased attention to other businesses in which he has been active and to various civic and philanthropic interests. He is president of Viking Automatic Sprinkling, Inc., Reuben L. Anderson and Associates, Inc., and American Grain Separator Co., treasurer of Minnesota Blue Cross, and executive committee and fund drive chairman for two local hospitals.

### Consulting Engineer Firms Effect Merger

The consulting engineering practice of C. D. Bassett has been merged with that of Cummins & Barnard, Inc., of Ann Arbor, Mich.

Mr. Bassett has been named vice president and director of the combined firm, in which the other principals are H. N. Barnard, R. J. Bowes, A. A. Cummins, R. W. Greenwood, J. H. Krick, C. F. North, F. Von Voigtlander, R. A. Sarri, and Hugh N. Barnard.

The original Cummins & Barnard firm was established in 1932.

# HOW TO SLEUTH OUT THE TRUTH ABOUT EXPANSION JOINTS

1 **Case the joint (design, that is)**

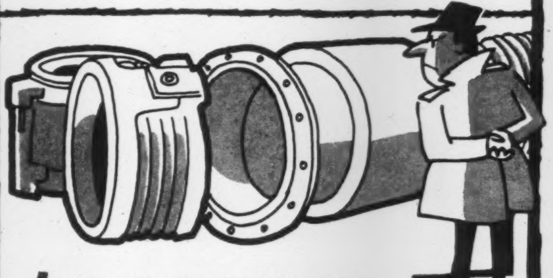
Badger S-R Expansion Joints have: 1. Corrugations which assume "all curve" shape under pressure — low stress, long life. 2. Tubular rings allow flexing over more of corrugation height.

2 **"Weigh" the evidence**

S-R Joints have no bulky castings . . . weigh up to 50% less . . . diameter equivalent to pipe flange. Installation is easier, lighter supports required.

3 **Search for clues in fabrication methods**

Bellows are hydraulically formed to produce uniform corrugations with minimum thinning of material. Quality controlled longitudinal welding, no multiple circumferential welds.



4 **Remember to look for accessories**

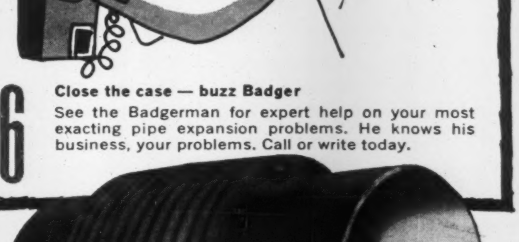
Full line of accessories — including covers and liners. Easy to pick proper combination of model, type and accessories for any pressure, temperature, erosive or corrosive condition.

5 **Pull an M.O. on the manufacturer's background**

Badger's 50-year experience includes development of first successful self-equalizing design for higher pressures, temperatures. Badger has had more fabrication and engineering experience in more different applications than any other manufacturer.

6 **Close the case — buzz Badger**

See the Badgerman for expert help on your most exacting pipe expansion problems. He knows his business, your problems. Call or write today.



**BADGER** S·R
*Expansion Joints*

BADGER MANUFACTURING COMPANY
230 Bent Street, Cambridge 41, Mass.
*Representatives in Principal Cities*

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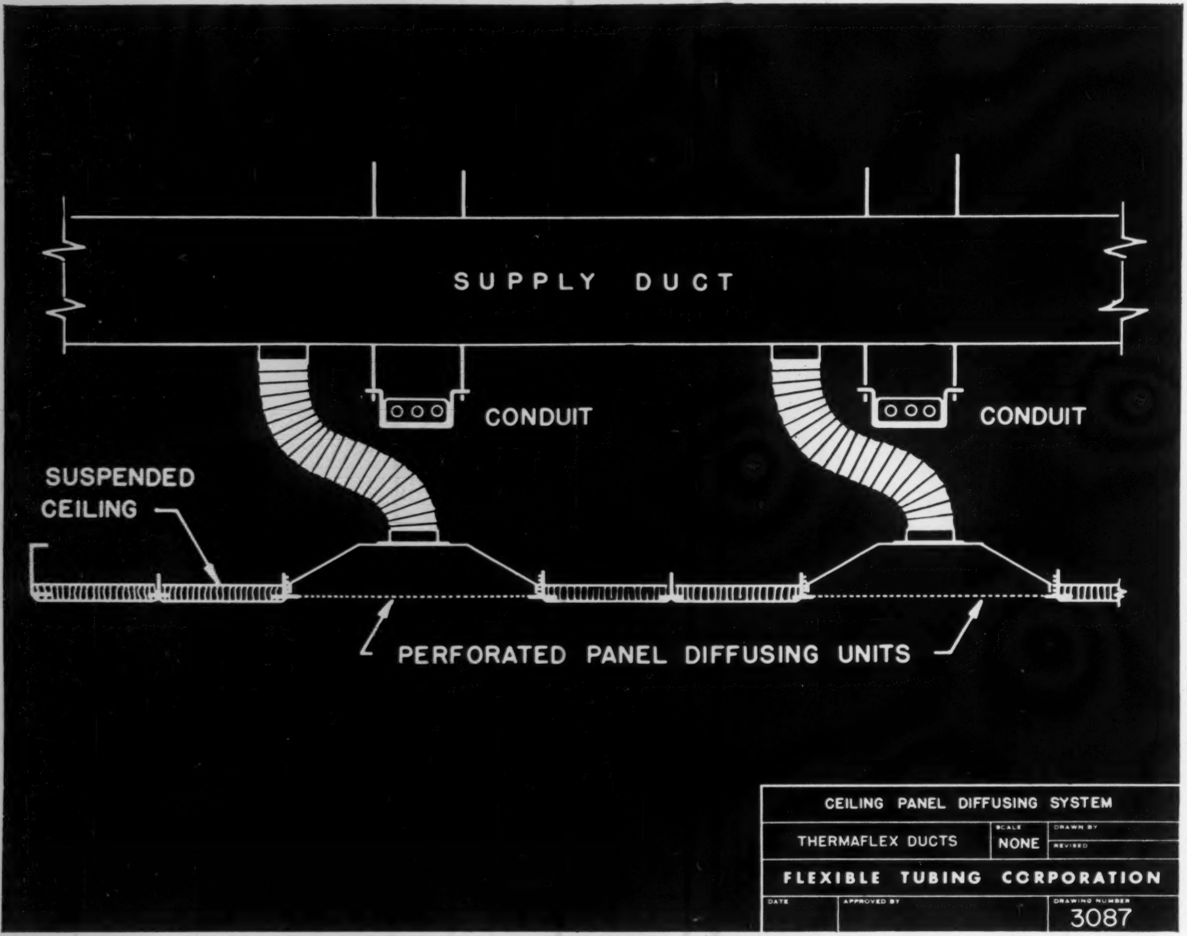
SUPPLY DUCT
CONDUIT
CONDUIT
SUSPENDED CEILING
PERFORATED PANEL DIFFUSING UNITS
CEILING PANEL DIFFUSING SYSTEM
THERMAFLEX DUCTS
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## In a ceiling distribution system...

# Flexible Tubing simplifies connections to diffusers...gives you greater design flexibility

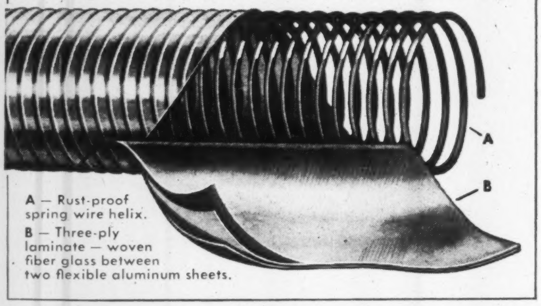
Flexible Tubing is the fast, easy way to connect supply ducts to diffusers in both low-velocity and high-velocity systems.

This lightweight, highly flexible duct is ideal where you have run-outs from a supply duct to a number of ceiling diffusers. Flexible Tubing corrects for *any* misalignment—permits diffusers to be moved during relocation of partitions without tearing out ceiling to reconstruct rigid ductwork.

Flexible Tubing snakes around sharp corners and through tight passages in gradual bends with minimum air flow loss. It's flameproof, moisture-resistant, long-wearing . . . greatly reduces mechanical noises due to vibration.

Get greater design flexibility in *your* next system . . . specify Thermaflex.® For the full story on Underwriters'-approved Thermaflex, write Flexible Tubing Corporation, 59 New Whitfield Street, Guilford, Connecticut. Fast technical and sales engineering service from 9 Regional Offices across the country.

**See why Thermaflex-A is so flexible and long-wearing!**



A — Rust-proof spring wire helix.
B — Three-ply laminate — woven fiber glass between two flexible aluminum sheets.

**Flexible Tubing**
CORPORATION
GUILFORD, CONNECTICUT
Anaheim (Los Angeles) • Hillside (Chicago)

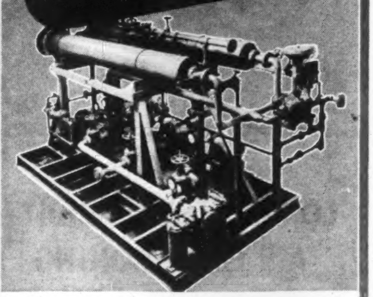
*save on installation and maintenance*

with

**EAGAN**

*"pre-packaged"*

**FUEL OIL PUMP and HEATER SETS**



Use an Eagan "pre-packaged" fuel oil pump and heater set for the preparation of heavy oil for combustion. You save time and money because units are completely assembled, ready for immediate installation. Only connections to oil and steam supply, burner, by-pass and relief lines have to be made and you avoid the combustion difficulties so often caused by field assembled combinations.

***Here are additional benefits Eagan gives you:***

- **Generous reserve capacity, at least 50% over peak burner demand, allows for eventual wear and future demand increases.**
- **Maintenance is easy and at a minimum. Parts requiring service are easily accessible.**
- **"Honest", solid construction, excellent engineering assure long life, trouble-free operation.**
- **Compact units save space.**

EAGAN fuel oil pump and heater sets heat to 300° F, pump to 400 psi and have capacities to 3000 gph. Single or duplex units are available for steam or electric drive. Duplex "electro-steam" sets provide for electrical failure by incorporating one steam pump and one electric motor driven pump. Other EAGAN sets can be made to your special requirements.

Write, wire or call for further information or let us bid on your job.

**WALTER H. EAGAN CO., INC.**
2337 Wallace Street, Phila. 30, Penna.
CEnter 6-2300

Mfrs. of condensate, boiler feed, turbine, centrifugal and proportioning pumps and fuel oil pump and heater sets.

***Pump Specialists Since 1920***

## RECENT TRADE LITERATURE . . .

▶ *AIR CONTROL VALVES*—illustrated specification catalog covers 2, 3, and 4-way inline, sub-based mounted 4-way, and 4-way 5 port types of air, solenoid pilot, double solenoid pilot, and pilot-booster valves; with selection and parts tables, cutaway construction drawings, and information on installation and maintenance. *Hoffman-Odom Co., 2360 W. Dorothy Lane, Dayton 39, O.*

▶ *AIR PUMPS*—descriptive price list "1360" covers line of rotary vacuum and pressure units, including oil-less models, with available sizes, and accessory line. *Leiman Bros., Inc., 102 Christie St., Newark 5, N. J.*

▶ *BACK-UP FLANGES*—in 3/4 to 1 1/2 in. ID iron pipe sizes and 1 through 1 3/4 in. OD seamless tube sizes, stainless or mild steel, feature two-part construction for ease of installation, handling, and maintenance, are detailed in specification sheet with quarter size model of flange attached. *Farwell Metal Fabricating, 81 W. Fairfield Ave., St. Paul 7, Minn.*

▶ *BALL VALVES*—for corrosive service made of unplasticized polyvinyl chloride or chlorinated polyether described in bulletin "TTP-180" with dimensions for threaded, socket, and flanged-end types in 1/2 through 2 in. sizes. *Tube Turns Plastics Inc., 2929 Magazine St., Louisville 11, Ky.*

▶ *BURNER NOZZLES*—application bulletin and catalog sheets Nos. "156A" and "155A" are combined in folder describing "Lo Flo" and "Vari-flo" air atomizing nozzles with variable capacities from 0.5 up to 150 gph depending upon pressure and fuel; larger sizes are by-pass or return flow design. *Delavan Mfg. Co., 811 Fourth St., West Des Moines, Ia.*

ALL WRAPPED UP WITH

**PIPING AND INSULATION**

The upsurge in demand for piping: alloy, stainless, cement, brass, copper, wrought iron, carbon steel; and new ways to insulate it with asbestos, plastic, fiberglas, ceramic, and other materials, keep men of power on their toes to keep in step with new, cost-saving developments.

Being on top of the latest developments is a prerequisite to more responsibility and advancement into jobs wanted by men anxious to grow. Attending the Power Show is vitally important to you . . . because it exposes you to up-to-the-minute developments in all phases of the power industry.

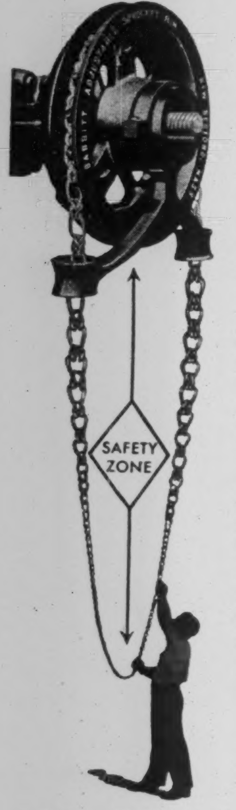
Only at the Power Show do you have the opportunity to investigate, compare and get the right answers, face-to-face, from the manufacturers themselves. Only at the Power Show can you see over 250 leading suppliers' products, all conveniently grouped together at one time.

Make sure you're there. Everyone else will be!

2446

**24th NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING**
AUSPICES ASME
**NEW YORK COLISEUM**
**NOV. 28—DEC. 2, 1960**
MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY
480 Lexington Ave., New York 17, N. Y.

**Babbitt**
*Adjustable*
**SPROCKET RIM**
*with Chain Guide*
**Changes that Danger Zone to a**
**SAFETY ZONE**



***. . . cuts costs when you***

**SIMPLIFY PIPE LAYOUT**

When you modernize to make money, go all the way. Cut piping costs to minimum with planned simplification. Give your staff a free hand to effect economies . . at the same time, convert Danger Zones to Safety Zones. Equip every overhead valve wheel in your plant with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. Just phone your mill supply salesman or contact us direct.

168-9

**Babbitt**
**STEAM SPECIALTY CO.**
8 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

## RECENT TRADE LITERATURE

*Continued*

▶ *CALCIUM CARBIDE AND ACETYLENE*— brochure discusses history of basic compound and its derivative, describes manufacturing process and numerous applications; with illustrations. *National Carbide Co., Div., Air Reduction Co., Inc.,* 150 *E. 42nd St., New York* 17, *N.Y.*

▶ *CENTRIFUGAL PUMPS*—bulletin "30" covers suspended and submersible models for industrial waste disposal; pumps are supplied in single or duplex arrangements for pit depths of up to 17 ft for suspended type or deeper with submersible variety; for capacities of up to 600 gpm at discharge heads up to 75 ft. *Walter H. Eagan Co., Inc.,* 2336 *Fairmount Ave., Philadelphia* 30, *Pa.*

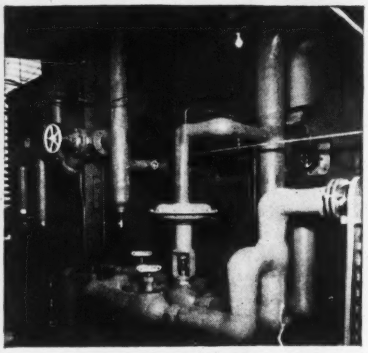
▶ *CORROSION INHIBITORS*—reprint of paper presented at 1960 National Association of Corrosion Engineers meeting discusses concept of high-level start-up dosages in open recirculating cooling water systems and once-through water systems. No. "92". *Nalco Chemical Co.,* 6216 *W.* 66*th Place, Chicago* 38, *Ill.*

▶ *CORROSION INHIBITOR*—designed to protect steam and condensate lines in boiler systems described in bulletin "B6-353". Agent is liquid that disperses in water in concentrations of from 5 to 50 percent. *Nalco Chemical Co.,* 6216 *W.* 66*th Place, Chicago* 38, *Ill.*

▶ *DUAL DUCT AIR CONDITIONER*—bulletin "DD-7" comprises guide to equipment offered by manufacturer, details features of high velocity systems, illustrates typical arrangements. *Buensod-Stacey Corp.,* 45 *W.* 18*th St., New York* 11, *N.Y.*

▶ *DUCT LINER*—of glass fiber is described in brochure "IN-302A" which stresses advantages claimed for "dual-density" design of semi-rigid

**DRY AIR...**
**PRECISELY AS YOU NEED IT**



**NIAGARA**
**CONTROLLED HUMIDITY**
**AIR CONDITIONING**

removes atmospheric moisture by direct contact with an absorbent liquid in a compact spray chamber. The spray contact temperature and the concentration of the absorbent liquid, two factors that are easily controlled, determine precisely how much moisture remains in the air leaving the unit.

This Niagara Controlled Humidity method, using Niagara Hygrol Absorbent Liquid is....

The only really precise method of air conditioning because it removes moisture as a separate function from heating or cooling to give you assurance of accuracy of air moisture control.

It is the most reliable because the absorbent is continuously and automatically kept at the proper concentration. No moisture-sensitive instruments are required to control your conditions.

It is the most flexible because with it you can either hold the precise condition you need as long as you wish or vary it with accuracy.

It is easiest to operate and maintain because the equipment and controls are simple and trustworthy.

This method is successfully used in the storage, testing and production of hygroscopic materials, in process control and as a pre-dehumidifier in comfort air conditioning.

***Write for Bulletins Nos. 122 and 140.***
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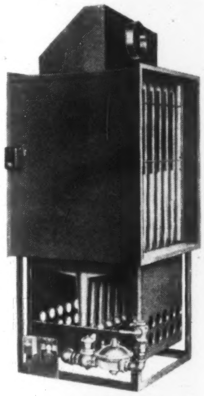
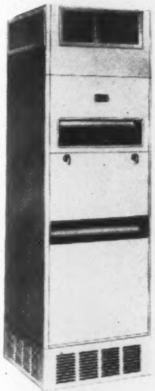
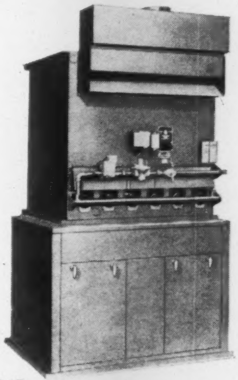


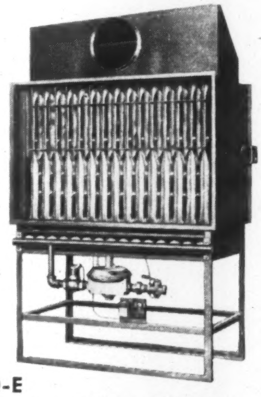
**SED-S**
Duct Furnace, 45,000 to 675,000 BTU Imput—End Surface



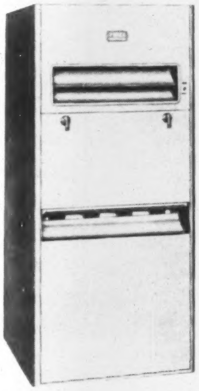
**SEU-V**
Vertical Unit Heater, 70,000 to 245,000 BTU Imput



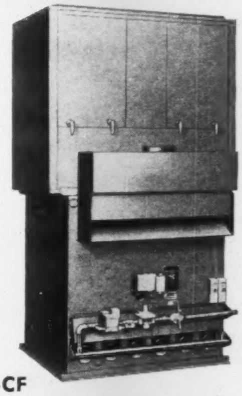
**SED-VF**
UP Vertical Duct Furnace, 70,00 to 280,000 BTU



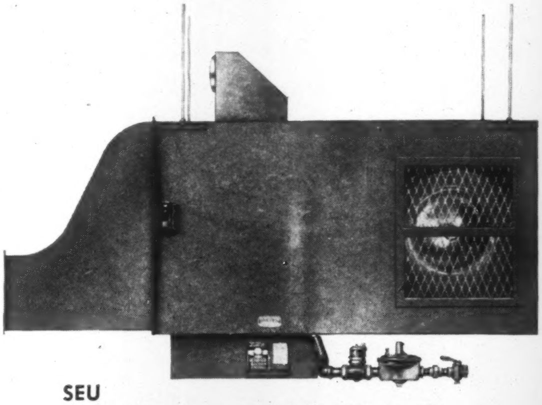
**SED-E**
Duct Furnace, 45,000 to 675,000 BTU Imput—Side Surface



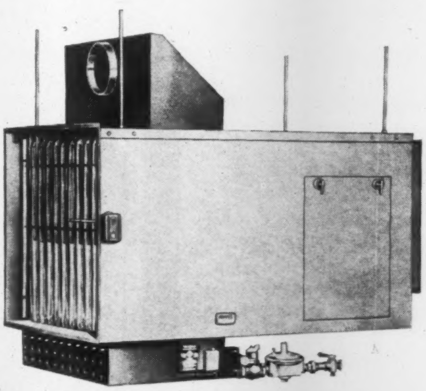
**SEC**
Forced Air Furnace, 70,000 to 245,000 BTU Imput



**SED-CF**
Counter Flow Duct Furnace, 70,000 to 280,000 BTU Imput



**SEU**
Suspended Unit Heater, 80,000 to 480,000 BTU Imput



**SES**
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## RECENT TRADE LITERATURE

*Continued*

blanket type insulation; with illustrations of application techniques, specifications for various thicknesses. *Johns-Manville, 22 E. 40th St., New York 16, N. Y.*

▶ *ELECTRIC MOTOR INSULATION*—descriptive sheet covers silicone rubber protection available for line of form-wound motors, 150 hp and up, provides information on new materials and application processes, environmental tests and engineering data. Bulletin "F-2022." *U. S. Electrical Motors Inc., P.O. Box 2058 Terminal Annex, Los Angeles 54, Calif.*

▶ *ELECTRICAL OPERATORS*—for remote control of circuit breakers covered in "how to apply" booklet; with illustrations of various applications. Booklet "B-7534." *Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.*

▶ *EXHAUST SYSTEMS*—for fume handling applications are fabricated from polyvinyl chloride, polyethylene and polypropylene to customer specifications, include all components from fan to outside weather cap, are described in new brochure with installation data sheets. *Industrial Plastic Fabricators, Inc., Endicott St., Norwood, Mass.*

▶ *FINPIPE RADIATION*—for hot water or steam applications in commercial, industrial, and institutional buildings covered in illustrated catalog which describes line of baseboard units and accessories available, with complete specifications, assembly and installation data, dimensional and performance tables. *Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.*

▶ *FLEXIBLE TUBING PRODUCTS*—for handling air, liquids, and

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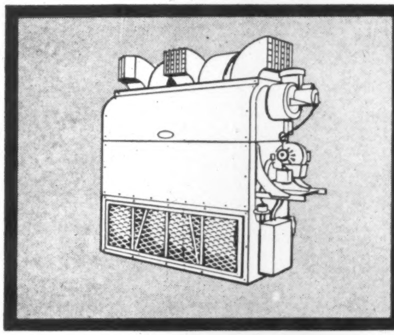
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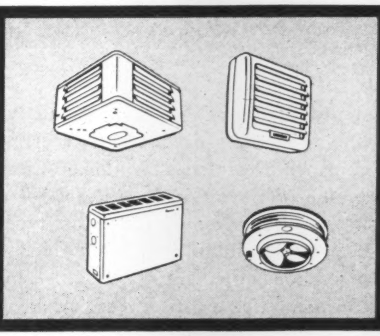
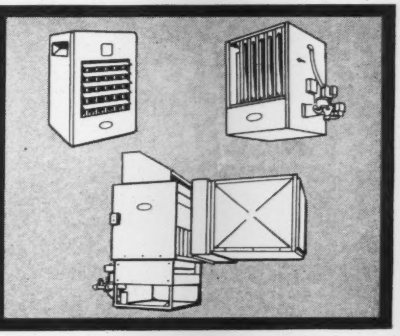
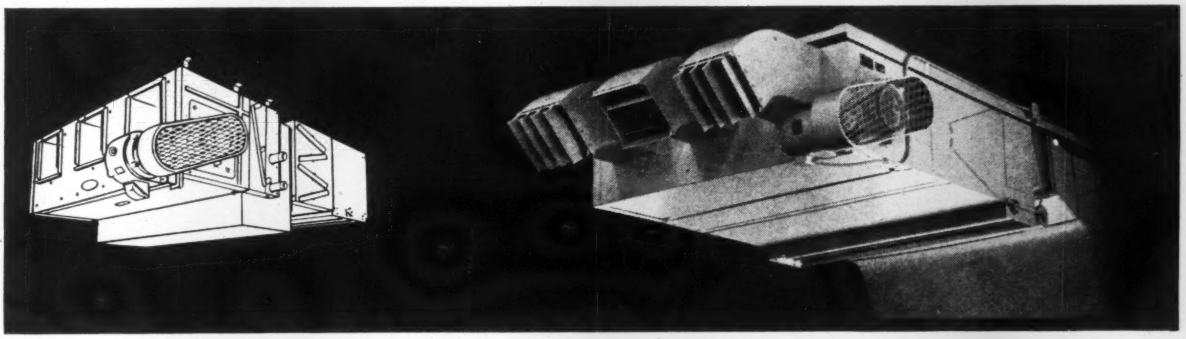

Unit Heaters
for steam and hot water


Gas Unit Heaters
and Duct Furnaces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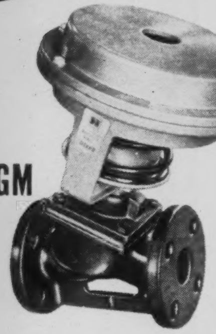

This valve uses a rubber diaphragm to seal the fluid in valve body and a rubber covered disc to close the valve tight. Penton coating of body provides protection against corrosive action. Valve has high capacity—low pressure drop. Available in ½" to 6" sizes; manual or mechanical operators. Air diaphragm operated unit shown here. Write for Bulletin 800C.

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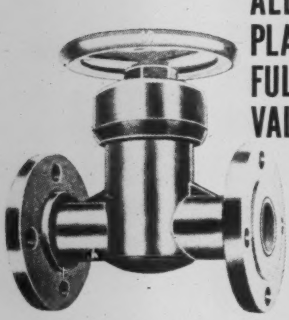

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light solids, of non-metallic design, described in new manual called "The Facts About Flexible Tubing." *Flexible Tubing Corp., Guilford 2, Conn.*

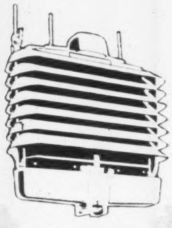
▶ *GALVANIC CORROSION*—occasioned by use of dissimilar metals in cooling systems discussed in reprint of paper presented at National Association of Corrosion Engineers meeting, with recommendations on type of corrosion inhibitors to be used for protection. Reprint "91." *Nalco Chemical Co., 6216 W. 66th Place, Chicago 38, Ill.*

▶ *GAS AIR CONDITIONING*—booklet describes and diagrams absorption, compression, and steam jet systems, describes gas-fired steam dehumidification systems, includes equipment data sheets from various manufacturers of equipment plus cost comparison tables for various methods of cooling. Called "Guide to Gas Air Conditioning." *The Peoples Gas Light and Coke Co., 122 S. Michigan Ave., Chicago 3, Ill.*

▶ *GAS BURNERS*—for high temperature applications, in two types, are described in new literature with thermal specifications, physical dimensions of 24 models of impinged jet and slotted cap jet units; information is presented in tabular form. *Barber Mfg. Co., Gas and Oil Burner Div., 1052-60 E. 134th St., Cleveland 10, O.*

▶ *GATE VALVES*—four catalog sheets describe line of iron body, bronze mounted non-rising stem screw and flanged end, and outside rising stem and yoke screw and flanged end valves, sizes 2 through 10 in. or 2 through 12 in. for 200 lb WOG service. Sheets numbered "16F," "17F," "19F," and "20F." *American Valve Mfg. Co., 22 Bayview Ave., Manhasset, L.I., N.Y.*

▶ *GLASS FIBER*—bulletin provides



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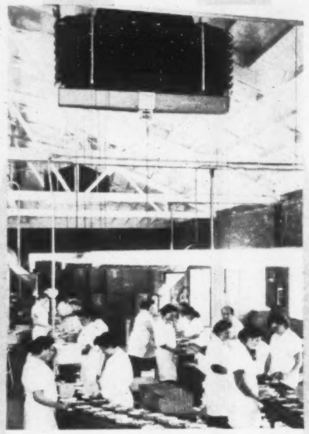

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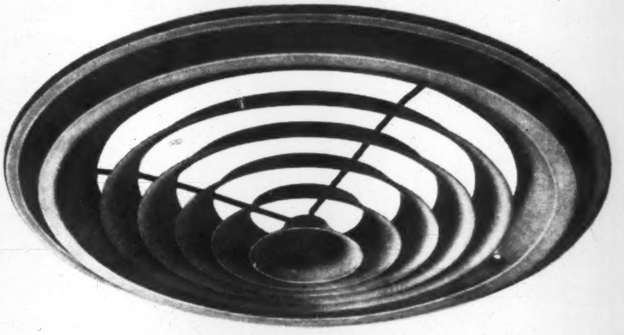

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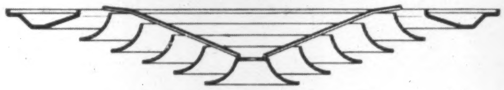

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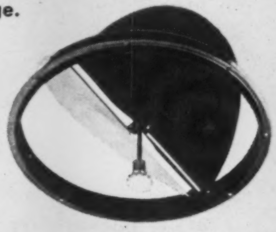

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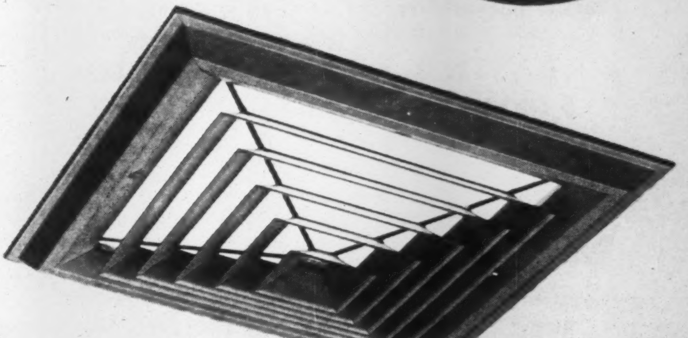

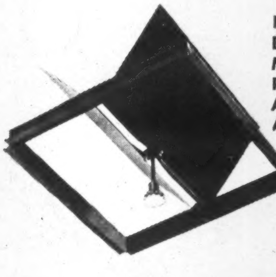

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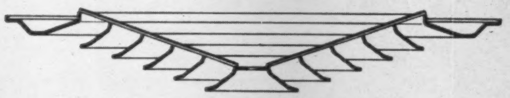

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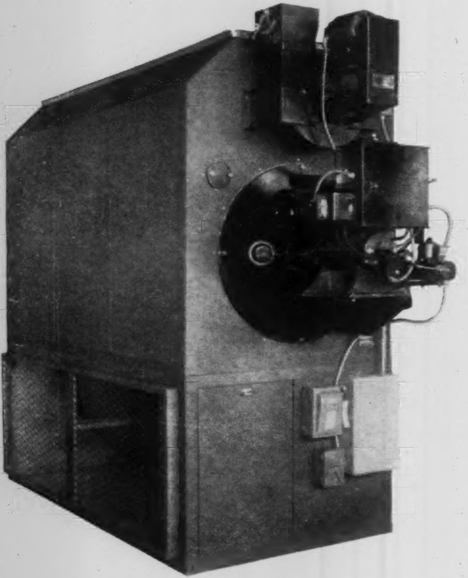

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*Continued*

technical data on properties for vibration mounting, acoustical insulation, and molded insulation, with performance data. *Fibrous Glass Products, Inc., Alpa Plaza, Hicksville, L.I., N.Y.*

*GRAPHITE CLOTH*—technical bulletin presents detailed property data on graphite woven fabrics in relation to industrial applications including high temperature resistance heating elements, space heaters, electrostatic precipitators, filters, condensers, others. Bulletin "101." *National Carbon Co.*, 270 *Park Ave., New York* 17, *N.Y.*

*HEAT EXCHANGERS*—catalog "6" covers storage water heaters, instantaneous water heaters and converters, condensate coolers, fuel and suction oil heaters, others. *The Patterson-Kelley Co., Inc., East Stroudsburg, Pa.*

*INDUSTRIAL WATER SERVICE*—brochure employs simulated interview technique to explain use of continuing consulting service for treatment of industrial water supplies, process control, reduction of corrosion problems, etc. *Hall Laboratories, Div., Hagan Chemicals & Controls, Inc., Hagan Center, Pittsburgh* 30, *Pa.*

*INSULATION JACKETING*—bulletin "ICB" describes aluminum covering for insulation protection on piping, tanks, towers; with illustrations of typical installations, summary of other available insulation accessory products. *Insul-Coustic Corp.*, 42-23 54*th Rd., Maspeth* 78, *N.Y.*

*MACHINERY MOUNTS*—of steel spring construction covered in catalog "K3C" with explanation of use in controlling vibration and shock, case histories and installation photographs, capacity and characteristic tables. *The Korfund Co., Inc.*, 48-01-*F* 32*nd Place, Long Island City* 1, *N.Y.*

*MACHINERY MOUNTS*—for metalworking machines, other installations, constructed of steel jacket, neoprene cushion in various stiffnesses for loads per mount of up to 13,000 lb. Bulletin "60-04.1." *Barry Controls, Inc.*, 700 *Pleasant St., Watertown* 72, *Mass.*

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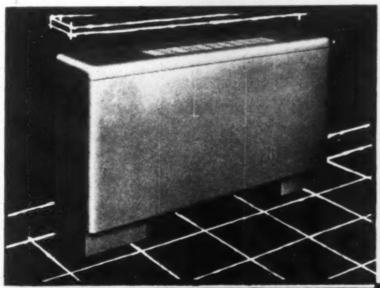

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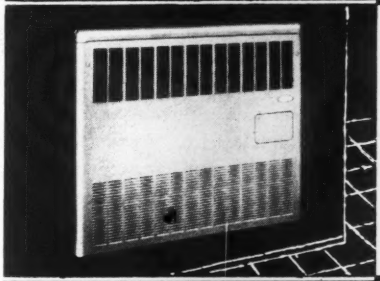

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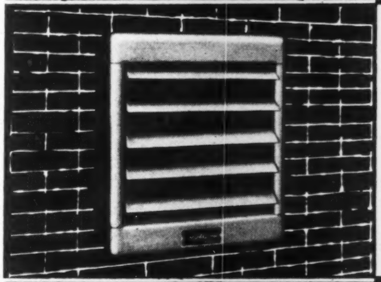

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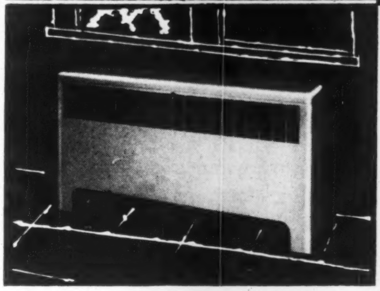

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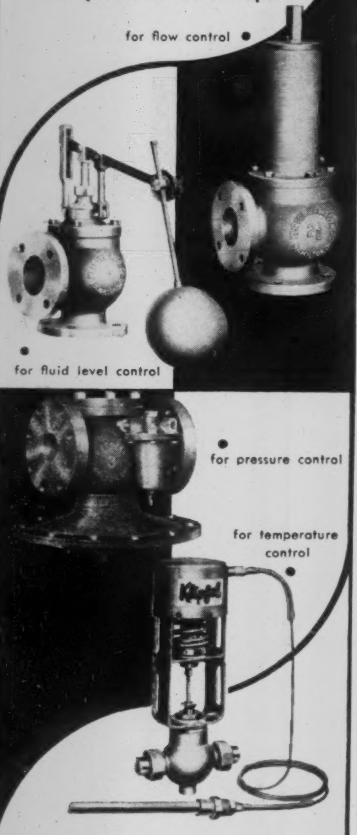

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## RECENT TRADE LITERATURE

*Continued*

▶ *OUTSIDE HEATING CONTROLS*—that operate with electric, steam, hot water, warm air, or radiant panel systems for industrial and commercial installations are described in new folder "G-0260." *Automatic Devices Div., American Machine and Metals, Inc., 714 Hillgrove Ave., Western Springs, Ill.*

▶ *PACKAGED AIR CONDITIONERS*—in free standing and wall-type cabinets described in bulletin "8825" with photographs of commercial installations, performance data, physical dimension and capacity tables. *American-Standard Industrial Div., Detroit 32, Mich.*

▶ *PACKAGED BEARINGS*—which run on "hydrodynamic" oil films described and illustrated in brochure which includes specifications on ten bearings in line, dimensions, operating characteristics, expected-life computation, torque consumed, and hp loss at various temperatures and speeds. *Tann Bearing Co., 2741 E. Congress, Detroit 7, Mich.*

▶ *PACKAGED BOILERS*—water tube design for high pressure steam requirements covered in bulletin "AD-186" with illustrations of engineering features, detailing of nation-wide service outlets plus summary of available fire tube boilers, deaerators, oil heaters, others. *Cleaver-Brooks Co., 326 E. Keefe Ave., Milwaukee 12, Wis.*

▶ *PACKAGED BOILERS*—bulletin "149D" describes "Kewanee" forced-draft Scotch type units for high and low pressure commerical and industrial applications, gas, oil, or combination fired from 82 to 691 hp; with illustrations, ratings, dimensions, and technical data tables. *American-Standard Industrial Div., Detroit 32, Mich.*

▶ *PACKAGED BOILERS*—horizontal 3-pass Scotch type gas, oil, or

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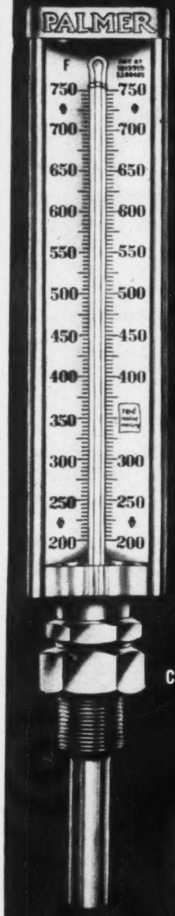

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**or Equivalent in °C**

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**Mfrs. of Industrial Laboratory, Recording and Dial Thermometers • Cincinnati 12, Ohio**

## RECENT TRADE LITERATURE

*Continued*

combination fired units of 80, 100, 125, 150, and 200 hp at 125 psi working pressure described in bulletin "A-104-3" with sequence of operation included to point up fail-safe controls. *Eclipse Boiler Div., Manufacturers Rd. & Compress St., Chattanooga 5, Tenn.*

▶ *PACKAGED BURNER SYSTEMS*—consisting of controls cabinet, preheater, air compressor, oil pump, and burner plenum mounted on welded base, in eleven sizes for from 68 to 934 hp are described in bulletin "1270" with illustrations of installations in schools, plants, and commercial buildings. *Orr & Sembower, Inc., Box 1138, Reading, Pa.*

▶ *PIPE CONNECTIONS*—and accessories including clamps, collar-type unions, flanges, vessel nozzles, closures, and bleeder valves presented in catalog with table of allowable working pressures for pipe and connections of from 1 to 30 in. diameter up to temperatures of 1500 F; includes details of sealing principle featured in connections. *Grayloc Sales Div., Gray Tool Co., P.O. Box 2291, Houston 1, Tex.*

▶ *PIPE REPAIR CLAMPS*—consisting of continuous gridded neoprene gasket backed by steel jacket which may be cut to desired length and secured with special bolted clamps detailed in folder with dimensional pipe size application tables. *Smith-Blair, Inc., 535 Railroad Ave., South San Francisco, Calif.*

▶ *PIPING SUPPORTS*—illustrated handbook gives application and installation information, specifications, and methods of attaching to structural surfaces and supports using line of metal framing devices; with engineering and performance data, drawings of framing commonly used in mechanical field. Titled "Unistrut Metal Framing Construction and Maintenance Handbook." *Unistrut Products Co., 933 W. Washington Blvd., Chicago 7, Ill.*

▶ *PLASTIC FILTER MATERIAL*—for use in removing submicron particles from fluids and gases treated in leaflet with table of flow rates and pore sizes, application suggestions, list of available types. *Gelman Instrument Co., 106 N. Main St., Chelsea, Mich.*

▶ *PLASTIC PIPE*—engineering and parts catalog describes corrosion resistant system including lines, sinks, traps, fittings, adapters, and other products; with section on fusion method of joining, technical and dimensional information, installation notes, tables of thread sizes, and chemical resistance information. *American Vulcathene Div., The Nalge Co., Inc., 75 Panorama Creek Dr., Rochester 2, N.Y.*

▶ *PLASTIC PRODUCTS*—for various applications including cor-

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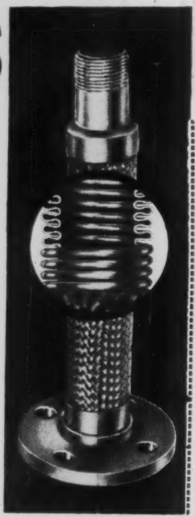

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## RECENT TRADE LITERATURE

*Continued*

rosive industrial uses described and illustrated in bulletin "D400" which presents data on the physical, mechanical, and electrical properties of phenolic and diallyl phthalate molding compounds, phenolic bonding and coating resins, and polyester resins; with photographs of typical product applications. *Hooker Chemical Corp., Durez Plastics Div., 8 Walck Rd., North Tonawanda, N.Y.*

▶ *PRESSURE REDUCING VALVES*—bulletin "402" discusses design, operation, and typical application of line of valves with capacity charts and steam consumption tables to aid in valve sizing. *Warren Engineering Co., Main St., Broadway, N.J.*

▶ *PRESSURE-TEMPERATURE COMPENSATION*—of fluid meters to determine actual flow by means of electric and pneumatic systems explained and illustrated in bulletin "21," with diagrams of installations, description of operation. *Bailey Meter Co.,* 1050 *Ivanhoe Rd., Cleveland* 10, *O.*

▶ *PROPELLER FANS*—catalog "DBI-100" presents selection tables for general purpose, high speed, direct drive tubeaxial duct, and explosion-proof models, with description of available accessories, plus wall and ceiling ventilators, and cooling and circulation fans for industrial and commercial uses. *Ilg Electric Ventilating Co.,* 2850 *N. Pulaski Rd., Chicago* 41, *Ill.*

▶ *REFLECTIVE INSULATION*—booklet presents information on techniques of industrial application, with explanation of dynamics of heat transfer, thermal efficiency, and condensation, plus comparison of thermal efficiency of various materials; with suggested specifications, titled "The Story of Reflective Insulation." *Reflectal Corp.,* 200 *S. Michigan Ave., Chicago* 4, *Ill.*

## RECENT TRADE LITERATURE

*Continued*

▶ *SPACE HEATERS*—gas or oil fired for industrial and commercial applications; with Btu per hr capacities from 200,000 to 1,250,000 detailed in series of specifications sheets "43-8, 9, and 10" with dimensional drawings, photographic reproductions. *Wanson Corp., Charles & Juniata Sts., Lewistown, Pa.*

▶ *STEAM ACCESSORIES*—including steam traps, temperature regulators, and heating specialties covered in condensed catalog with dimensional and capacity data. *Sarco Co., Inc., 635 Madison Ave., New York 22, N.Y.*

▶ *STORAGE WATER HEATERS*—of various types including vertical and horizontal models of steel construction, copper and cement lined, metal clad, others, detailed in catalog "19" with storage and heating capacities, dimensions, construction material thicknesses, plus section on installation. *The Patterson-Kelley Co., East Stroudsburg, Pa.*

▶ *STORAGE WATER HEATERS*—gas fired, described in catalog "4" which covers design, operation, and construction features of 250 to 4000 gal units with recovery ranges from 375 to 2125 gph; includes diagrams and schematic drawings to define three basic systems available. *The Patterson-Kelley Co., Inc., East Stroudsburg, Pa.*

▶ *SUN SHIELDS*—of various types for outside building installation, including cantilever, horizontal suspended, cantilever airfoil, horizontal airfoil, rectangular panels, and vertical airfoils, plus "Z" blade, honeycomb-hex, and octalinear varieties detailed in catalog with detailed drawings, application photographs. *Construction Specialties, Inc., 55 Winans Ave., Cranford, N. J.*

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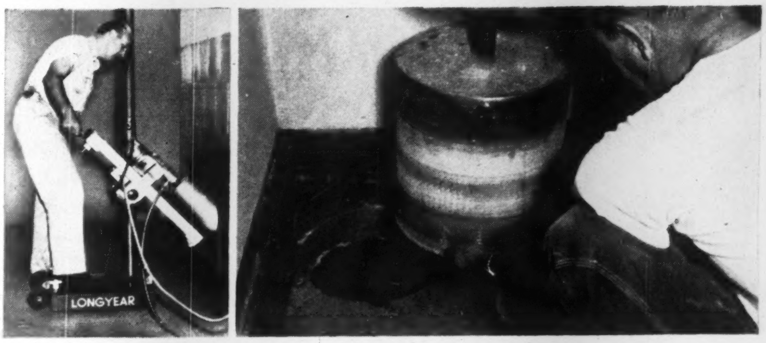

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Hundreds of 14-inch holes and many smaller ones were drilled with Longyear diamond bits through 5-inch terrazzo and reinforced concrete floors to air condition a 32-story office building. Each of the 14-inch holes took only 5-10 minutes of actual drilling time, and every Longyear bit drilled 100-120 holes! Every opening was clean and even, requiring no patch-up, and total cost of this big drilling job was surprisingly low. See your Longyear dealer and find out how the new Longyear industrial diamond drills can knock down your drilling costs.

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| ALL THESE STOCK SIZES | IN ALL THESE LENGTHS |
|---|---|
| 1/4" | 12" |
| 3/8" | 18" |
| 1/2" | 24" |
| 3/4" | 30" |
| 1" | 36" |
| 1 1/4" | 48" |
| 1 1/2" | 60" |
| 2" | 72" |

LARGER & LONGER SIZES AVAILABLE

FROM **STOCK** FOR FASTEST SERVICE

- STAINLESS STEEL
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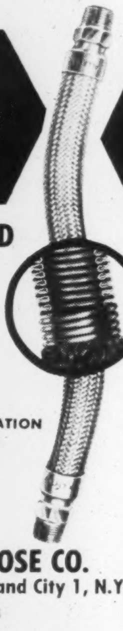

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608 HPA/960

Heating and Air Conditioning

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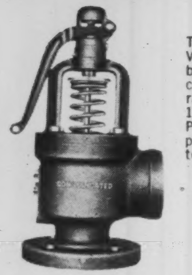
CONTROL

CONSOLIDATED SAFETY VALVES GIVE POSITIVE *PROTECTION*



Type 1511 Safety Valve. Cast iron body. Maximum capacity for saturated steam. Sizes: 1½" through 6". Pressures to 250 psi. Temperatures to 450°F.

Make certain steam, air and gas pressures are held within safe limits on your heating, piping, and air conditioning projects. Consolidated Safety Valves automatically relieve overpressures in everything from package-type boilers and large steam generators to air tanks and other unfired pressure vessels. A 2100-pound design boiler is used to test and set these valves—to guarantee capacities and assure the best protection. Typical plus values of Consolidated Safety Valves are exemplified in the Type 1511:

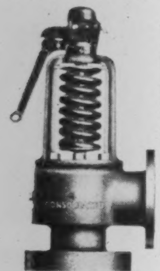
**Compactness** saves space and headroom; permits the use of smaller, more economical discharge piping.

**Lower Cost** per pound of steam discharged because maximum capacity is designed into minimum flange size. Fewer or smaller safety valves can be used on a boiler.

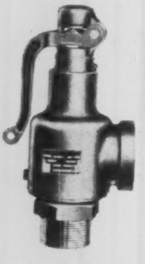
**Better Alignment** through double-guided adjusting ring and disc guide assures easier, more uniform blowdown adjustment and control, and finer operation.

**Positive Tightness** is created because the seat is machine-lapped to optical flatness.

On large or small installations, spring-loaded Consolidated Safety Valves give positive protection to personnel and facilities. Whatever the working pressures and temperatures of your heating, piping and air conditioning projects, choose Consolidated. Precision-made with few working parts, they are tough, long-life safety valves that rarely require maintenance. *Write for Catalog 700A.*



Type 1415 Safety Valve. Cast steel body. High capacity for saturated and superheated steam. Sizes: ½" through 6". Pressures to 900 psi. Temperatures to 900°F.



Type 1551 Safety Valve. Bronze body. For steam, air, gas. Sizes: ⅜" through 3". Pressures to 300 psi. Temperatures to 450°F.

ASME Standard • ASME Tested • National Board Certified

**CONSOLIDATED SAFETY VALVES**
*A product of*
**MANNING, MAXWELL & MOORE, INC.**
*Valve Division • Stratford, Connecticut*
*In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ont.*

## RECENT TRADE LITERATURE

*Continued*

▶ *TEMPERATURE REGULATORS*—catalog "J180-1" presents information on line of sliding gates and plate temperature models for use on steam, water, air, oil, gas, or chemicals at temperatures from 35 to 450 F, pressures up to 250 psi; includes illustrations of self and pilot operated, and combination pressure-temperature units. *OPW-Jordan, 6013 Wiehe Rd., Cincinnati 13, O.*

▶ *THERMAL-ACOUSTICAL INSULATION*—technical bulletin "J-661" provides information on mineral wool material designed for service from below zero to 450 F, in six standard densities of from ½ to 3 lb per cu ft; with tables of thermal conductivity at various temperatures, plus acoustical efficiency tables, and standard width and length data. *Baldwin-Ehret-Hill, Inc., 500 Breunig Ave., Trenton 2, N.J.*

▶ *THERMOCOUPLE COMPONENTS*—catalog "C 100-3" gives specifications and ordering information on replaceable components for manufacturer's assemblies. Bare elements, insulated elements, insulators, metal and ceramic protecting tubes, heads, blocks, connectors, and miscellaneous fittings covered. *Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia 44, Pa.*

▶ *TIMING DRIVE SELECTION*—bulletin "21103" presents method for selection of timing belt drives to fit variety of applications, with curves for drive width selection; includes illustration by way of sample problem; booklet is meant for use with any standard timing belt catalog. *T. B. Wood's Sons Co., Chambersburg, Pa.*

▶ *VALVES*—over 100 different types of shut-off, pressure relief, flow check valves plus driers, strainers, liquid gages, flanged unions, liquid indicators, others detailed in catalog "104" which also gives special attention to moisture-liquid indicators for use in determining refrigerant condition. *Henry Valve Co., 3215 North Ave., Melrose Park, Ill.*

## RECENT TRADE LITERATURE

*Continued*

▶ *VALVE LUBRICATING SYSTEM*—for plug valves described in bulletin which shows construction of automatic lubricator, gives installation and operation information, plus details on proper adjustment; device is accessory for firm's line of valves which provides continuous and regulated supply of lubricant. *Rockwell Mfg. Co., 100 N. Lexington Ave., Pittsburgh 8, Pa.*

▶ *VENTILATION BLOWERS*—line of direct and V-belt driven sets discussed in catalog "1160" with engineering data for models with capacities up to 21,500 cfm at static pressures of up to 2-½ in. WG. *Westinghouse Electric Corp., Sturtevant Div., Dept. 242, Hyde Park, Boston 36, Mass.*

▶ *WATER CONDITIONING*—data sheets titled "How To Extend Cooling Tower Life," and "Newest Approach to Steam Purity Measurement" discuss deterioration of tower wood by chemical, biological, and physical phenomena, and the effect of sodium content in steam on turbine and superheater deposits, respectively. *Betz Laboratories, Inc., Gillingham and Worth Sts., Philadelphia 24, Pa.*

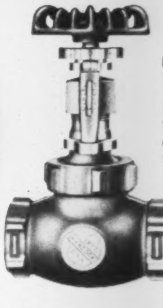
▶ *WATER HEATERS*—for systems using steam or hot water are discussed in guide which explains how to determine type of heating unit needed to meet various temperature and volume requirements; booklet correlates these requirements plus available steam pressure factor to model numbers of available units. Bulletin "TH-160" *Bell & Gossett Co., 8200 N. Austin Ave., Morton Grove, Ill.*

▶ *WELDING TRAINING AIDS*—folder lists books on wide variety of welding subjects, plus welding educational films, codes, and specifications. *Hobart Welding School, Troy, O.*

▶ *TESTING UNITS*—for checking tripping characteristics of motor starters, and small magnetic and thermal circuit breakers featured in bulletin "SB-MSR-1" which covers use of either of two available models for above tests plus pick-up, reset, and time-current characteristics. *Multi-Amp Div., Multi-Amp Electronic Corp., Dept. MSR, Box 217, Union, N.J.*

Heating and Air Conditioning
FLOW
CONTROL

HANCOCK VALVES DO THE JOB *ECONOMICALLY*



Bronze "Flocontrol" Valves. ¼" thru 2". "500 Brinnell" stainless steel V-port disc. Variable orifice, shut-off and index in one valve.

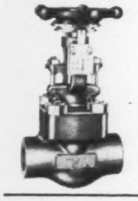
Reliable control of flow contributes substantially to complete owner satisfaction with every heating, piping, and air conditioning system you install.

Whether the application demands pin-point control of flow or full flow, Hancock Valve performance proves there is no substitute for the economy of quality. Highest operational perfection is combined with lowest maintenance. Whatever the piped medium – fuel oil, gas, water, or steam – the quality of Hancock Valves helps assure uninterrupted service. Typical advantages of Hancock Bronze and Steel Valves are:

**RUGGEDNESS** that continues to ward off the deteriorating effects of wire drawing, galling, steam cutting, erosion and corrosion long after ordinary valves fail.

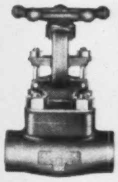
**MAINTENANCE ECONOMY** because carefully selected materials are precision-formed into functional parts of long-lasting efficiency. Servicing can be done in the line. Standardization of components means inventory economy.

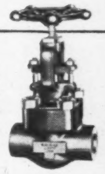
Learn all the job-proved reasons why Hancock Valves are today's best buy in terms of your standard of reliability. Globe, Angle, Gate, and "Flocontrol" types available with application characteristics suited to your heating, piping, and air conditioning requirements. *Write for Catalog 200A.*



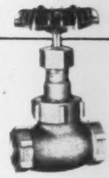
Steel "Flocontrol" Valves. ¼" thru 2". V-port disc compels proportional flow thruout the lift of the stem.

600# Steel Gate Valves. ¼" thru 2". Forged steel body. Maximum use of stainless steel.





600# Steel Valves. Globe and Angle. ¼" thru 2". Forged steel body. "500 Brinnell" stainless steel disc.



Bronze Valves. Globe and Angle. ¼" thru 2". "500 Brinnell" stainless steel seat and disc. 125% to 230% stronger diaphragm.

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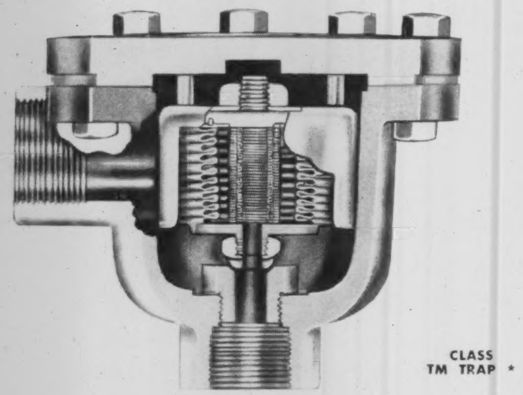

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SQUIRES HAS DEVELOPED A MODULATING STEAM TRAP

A unique double bellows design, balances force across the seat preventing on-off cycling, permits trap to modulate open only to the degree of and instantly removes all condensate and air from the trap. Check the following advantages to various individuals effected by steam operation:

**DISTRIBUTION** — Easy to stock, light weight and compact, one trap without orifice change will provide top efficiency from 1 to 150 psig steam operations.

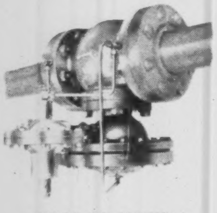
**OPERATION** — Reduced trap policing, internal (double bellows) design avoids trouble points requiring high rate of maintenance, repair and replacement. Non-freezing.

**OWNER** — Savings alone from steam bleed through, usually prevalent in a cycling trap, would purchase two Class TM replacement traps per month.

**SPECIFICATION** — Modulating design permits use of larger orifices (5/8″ on 1″ size Class TMD), thus greater capacity, i.e. 35,000 lb/hr at 150 psi differential pressure.

ALSO A COMPLETE FACTORY PREFABRICATED REGULATOR STATION

- SPEEDY INSTALLATION
- ACCURATE CONTROL
- WIDE RANGE
- ALL PURPOSE



CLASS AD VALVE *

The Squires Class AD Valve provides many exclusive control features:

- **INSTALLATION** — Furnished completely piped, Contractor merely bolts in place, puts in service, makes no call backs.
- **ACCURATE CONTROL** — Reacts instantaneously to even minor down-stream pressure changes, with no hunting at low loads.
- **WIDE RANGE** — 600 to 1 psi and intermediate one step reductions, extremely large capacity, dead end qualities.
- **ALL PURPOSE VALVE** — Packless, self contained, the same valve can be utilized on steam, water, gas, air, most fluid services.

*Write for complete information and engineering details on the Class TM Trap, Class AD Valve and other pressure, temperature and level controls of the wide Squires Line.*

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**THE C. E. SQUIRES CO.**
18502 SYRACUSE AVE.
CLEVELAND 10, OHIO
REPRESENTATIVES IN PRINCIPAL CITIES

## WE HEAR THAT . . .

▶ Ground has been broken for a new plant of 100,000 sq ft in Greenville, Ala., for *ACME INDUSTRIES, INC.* Completion is scheduled for early October.

▶ *THE STEEL BOILER INSTITUTE* has announced publication of the eighth edition of the *SBI RATING CODE*, reported to contain more revisions than any previous edition, including a new section for boilers which are mechanically fired with mechanical draft.

▶ *THE BRISTOL CO.*, a subsidiary of *AMERICAN CHAIN & CABLE CO., INC.*, has acquired *HANSON-GORRILL-BRIAN, INC.*, manufacturer of servo control amplifiers, infrared pyrometers and detection instruments, and other products.

▶ *TEMTROL DIV., PENN CONTROLS, INC.*, has completed and occupied a new building at Costa Mesa, Calif., which becomes the headquarters for the firm's west coast operations.

▶ Plans to construct a new Elizabeth, N. J., plant for the production of fluorinated hydrocarbon refrigerants have been revealed by the *GENERAL CHEMICAL DIV., ALLIED CHEMICAL CORP.*

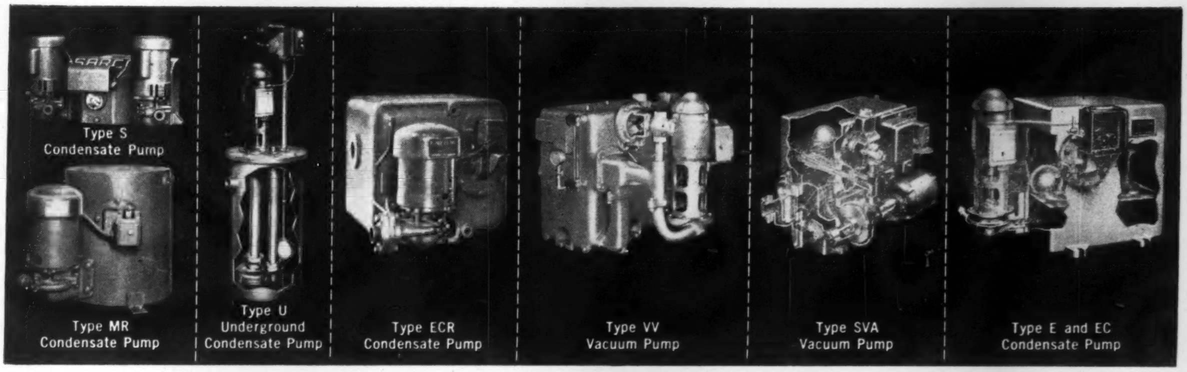
▶ The Stratford, Ontario production facilities of *CLEAVER-BROOKS CO.*, will be expanded by 25 percent to include four separate bays for sub-assembly and final assembly of the firm's line of packaged boilers.

▶ *MORRISON PRODUCTS, INC.* has signed 10 year licensing agreements covering its line of air moving equipment with three European manufacturers: *ERCOLE MARELLI & CO.*, Milan, Italy, *A. B. BAHCO*, Stockholm, Sweden, and *AMENT ENGINEERING CO., LTD.*, London, England.

▶ *CENTRAL FUEL CO. MARYLAND, INC.*, Baltimore fuel oil and burner service facility, has announced removal of its operations to larger quarters at 2109 W. Lafayette Ave., Baltimore.

▶ *BENSON MFG. CO.* has announced the establishment of a separate commercial blower division in Kansas City, Mo.

▶ *THE AMERICAN GAS ASSOCIATION* has predicted that the industry will spend a record breaking $2.233 billion in 1960 for new plants and facilities, topping the $1.772 billion peak reached in 1957.



## choose from a complete line of
## SARCO CONDENSATE and VACUUM PUMPS

**SARCO CONDENSATE PUMPS** discharge to boilers fast . . . give quiet, dependable operation . . . are constructed of finest materials . . . engineered for quick, easy installation to meet a variety of conditions . . . have steel or cast iron receivers and close coupled or flexible coupled motors.

**SARCO VACUUM PUMPS** have a reputation for quality based on a quarter century of experience and development . . . feature jet vacuum-producing unit—highly efficient in producing high vacuums and maintaining full rated water capacities . . . have flexible coupled motors and cast iron receivers.

**WHAT ARE YOUR PUMP NEEDS?** Make use of Sarco's wide and specialized experience in heating problems involving fluid movements. For information on Sarco condensate and vacuum pumps, all guaranteed for one full year, contact your Sarco sales representative, district office, or distributor; or write:

2362

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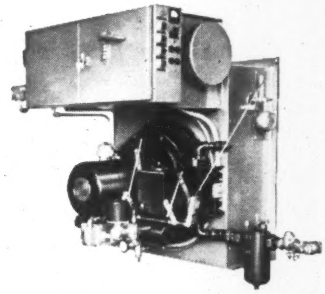
***Get Smooth . . . Quiet . . . Exceptionally Efficient Combustion regardless of Stack Conditions and Firebox Pressures!***

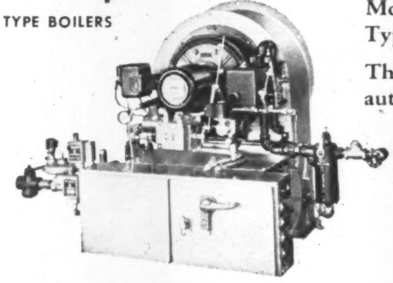


FOR FIREBOX TYPE BOILERS

These compact burners are available for firing on Oil only . . . Gas only . . . and for Combination Oil or Gas firing. With either fuel, they deliver low-cost heating with a minimum of servicing and supervision. There's a size for every heavy-duty heating need, from 28 HP to 560 HP.

These "package-unit" burners come to you completely assembled, wired and tested . . . ready for quick, inexpensive installation. Models are available for use with either Scotch Type or Firebox Type boilers.

They are powered by the world famous Johnson 53 Burners which automatically maintain a fixed air-fuel-ratio regardless of variations in oil viscosity . . . thus insuring easier, faster "cold starts" when the oil in tank and fuel lines is cold and hard to pump. If you seek truly fine performance and low operating costs on your big heating jobs, by all means check up on these Johnson Forced Draft Burners.



FOR SCOTCH TYPE BOILERS

*Johnson Burners*

S. T. JOHNSON CO.
940 Arlington Ave., Oakland 8, Calif.
Church Road, Bridgeport, Pennsylvania

**Builders of fine Oil Burner Equipment since 1903**

**The most valuable instrument in the tool kit for the**

**HEATING AND AIR CONDITIONING CONTRACTOR**

**Alnor PYROMETER**

Registers temperatures accurately and instantly by simply touching the Pyrometer tip to any surface, or will register air temperatures at grilles, inside ducts etc. with the air temperature thermocouple tip.

Save time with quick positive readings, avoid trial and error methods, eliminate call backs.

With the Alnor Pyrometer you can—

- Set thermal expansion valve on cooling coils in less than a minute.
- Balance hot water systems right the first time.
- Get accurate readings on the effectiveness of insulation.
- Test temperatures of walls, floor, ceilings.
- Locate hot water pipes in cement floors.
- Use it any place where surface temperature readings are required.

**Model 2300B.** Has full 6 inch mirrored scale. Temperature range −40°F to 200°F. Complete unit in attractive durable case. Price $195.00.

*Just tear out this ad and mail with your letterhead to*

Alnor INSTRUMENTS

**ALNOR INSTRUMENT CO.**
Division of
Illinois Testing Laboratories, Inc.
Rm. 513, 420 N. LaSalle St., Chicago 10, Ill.

## WE HEAR THAT

*Continued*

▶ *HOOVER BALL AND BEARING CO.* has consolidated all ball manufacturing, engineering, sales, and administrative functions in the *HOOVER BALL DIV.*, with headquarters at Middletown, O.

▶ Carroll M. Baumgardner is relinquishing his staff duties as director of *NATIONAL-U. S. SALES DIV., CRANE CO.*, under the early retirement provisions of the company's pension plan, but will continue to be available to the firm for consulting purposes.

▶ *TECHALLOY CO., INC.*, has opened a new 4000 sq ft research and development laboratory for its expanded strip production facilities, and has installed equipment to help in the application of high nickel alloys to customer specifications.

▶ *ARMSTRONG CORK CO.* has announced the formation of a subsidiary company, *ARMSTRONG CORK (PTY) LTD.*, with headquarters in Johannesburg, South Africa, and has also revealed a major expansion program for the firm's acoustical and fiberboard manufacturing facilities in Pensacola, Fla.

▶ *HART & COOLEY MFG. CO.* is constructing a 912,000 cu ft warehousing facility in Holland, Mich., for service of the company's line of gas vent pipe and fittings.

▶ A new leasing plan covering all types of non-expendable equipment in a full range of sizes has been announced by *AMERICAN STANDARD INDUSTRIAL DIVISION*.

▶ *GOODYEAR PUMPS, INC.*, has revealed the signing of a manufacturing agreement with *WARREN PUMPS, INC.*, initiating American production of the former firm's "Archimedean" screw pump line.

▶ Manufacture of *ECLIPSE FUEL ENGINEERING CO.* packaged boilers and boiler accessories has been moved to newly acquired facilities in Chattanooga, Tenn., from Rockford, Ill.

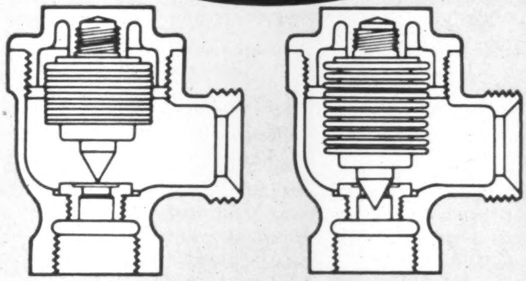
▶ *HYDROTHERM, INC.*, has enlarged by twenty-five percent its hot water boiler manufacturing facilities in Northvale, N.J.

▶ *THE STANDARD MFG. CO.* has acquired the *AUTOMATIC HUMIDIFIER CO.*, and will operate the new acquisition as a division.

# SIMPLE, TROUBLE-FREE VACUUM THERMOSTAT DESIGN ASSURES EFFICIENT, ECONOMICAL STEAM TRAP OPERATION

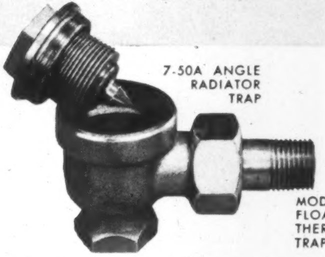
**Sterlco®**

STEAM TRAPS

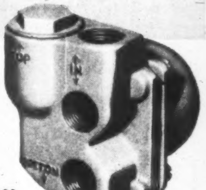


Thermostat in open position — Thermostat in expanded position

1. **Sterlco Traps operate efficiently regardless of pressure variations. *Vacuum thermostat* compensates for pressure changes.**
2. **While vacuum in thermostat remains intact, traps require no attention other than normal maintenance.**
3. **If, through damage or normal wear, the vacuum is lost, the thermostat expands, closing off trap and radiator. Locating source of trouble is made quick and easy. Trap maintenance is greatly simplified.**
4. **Closed traps mean no wasted steam . . . vacuum on vacuum systems remains normal . . . condensation and vacuum pumps are not endangered by steam in return lines.**



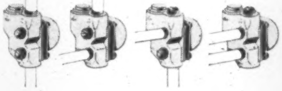
7-50A ANGLE RADIATOR TRAP



MODEL 69B FLOAT AND THERMOSTATIC TRAP

The Sterlco line covers the whole range of low, medium and high pressure radiator traps. Every unit thoroughly tested . . . components inspected and tested during manufacture; completed traps given operating tests before shipment. Thermostats and seats replaceable without shimming or adjustment.

Sterlco F & T traps perform dual function: float trap releases condensate water . . . thermostatic trap vents air. No. 69B has two inlets, two outlets making four installation positions possible . . . saves time, space and piping.



***For complete information on Sterlco Steam Traps, write for Bulletin 102.***

**Leaders in temperature controls since 1916**

## Sterling inc.

5202 W. Clinton Ave., Milwaukee 23, Wisconsin

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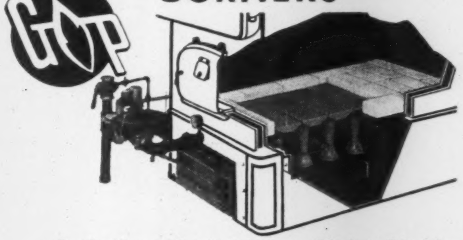
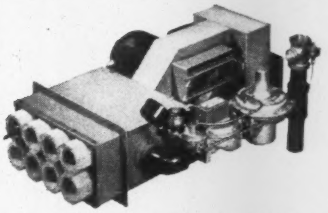
# "Planned Performance"*

## BURNERS



For heating and power boilers. 23 sizes listed in Catalog No. A-10.

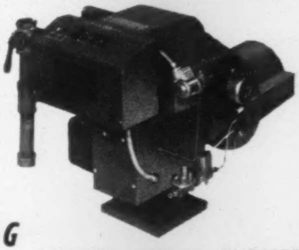
**BLUE LINE UPSHOT ATMOSPHERIC GAS BURNER**



Fully automatic, packaged assembly. Sizes listed to 28 million BTU/HR in Catalog C-10

**TURBO-FIRE POWER TYPE GAS BURNER**

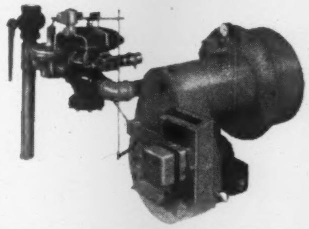
MODEL R
Capacities up to
2¼ million BTU/HR
Catalog E-61



## TURBO-RING FORCED DRAFT BURNERS

Gas, oil, or combination Gas-Oil burner. No stack required on boilers equipped for pressure firing.

MODEL FGR
Capacities 1 to 9
million BTU/HR
Catalog E-51

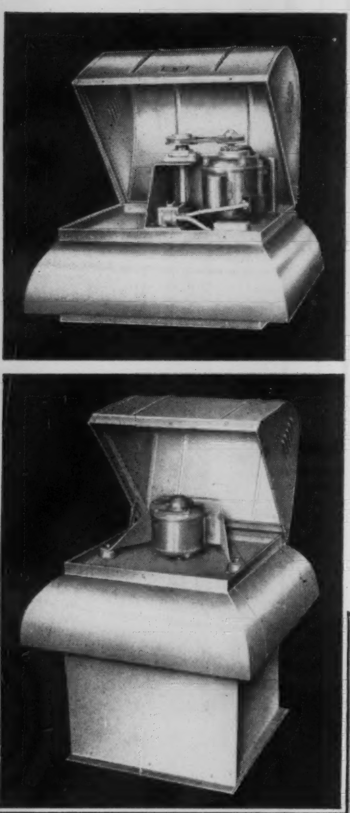


* PLANNED — Factory assembled, pre-wired for "Bolt-in" installation.

* PERFORMANCE — Custom matched to individual boilers for quiet, efficient operation.

Gordon & Piatt also manufacturer of a complete line of domestic conversion burners plus large dual-fuel units. Write for literature and complete information.

**Gordon & Piatt**
P. O. Box 914
Winfield, Kansas

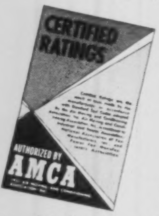


**Aladdin**

AIR HANDLING EQUIPMENT

**ROOF VENTILATORS**

- **THIRTEEN SIZES**
- **SELF CONTAINED**
- **QUIET OPERATING**



**ALADDIN Type V Roof Ventilators** are available in a complete range of sizes . . . direct and belt driven. Units can be furnished in both curb mounted or extended base types. Ruggedly built, the type V units have been designed for those installations where positive year around powered ventilation is required, and when properly installed, will give years of efficient trouble free service.

***Write for complete data*** 4

**ALADDIN HEATING CORPORATION**
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

## WE HEAR THAT

*Continued*

▶ Construction has begun on a 10,000 sq ft engineering space addition to the *ROBERTSHAW-FULTON GRAYSON CONTROLS DIV.* plant.

▶ *PETER BEN GORDON* has been named as the 1960 recipient of the F. Paul Anderson Award, highest honor conferred by the *AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS* for his ". . . conspicuous contributions to the advancement of this society, to that of his chosen profession, the industry with which his activities have been allied, to the encouragement and instruction of younger engineers and to the resultant public welfare."

▶ *ENGINEERS, INC.* has recently purchased and beginning at year's end will occupy a three-story building at 20 Mt. Pleasant Ave., Newark, N.J., to be known as Engineers Incorporated Building.

▶ *PACO INDUSTRIES, INC.* has moved to new facilities at 465 S. Dean St., Englewood, N.J.

▶ *PIONEER MFG. CO.* has opened a new 1000 sq ft air conditioned display and sales room with exposed cooling system at its Los Angeles plant.

▶ *YUBA CONSOLIDATED INDUSTRIES, INC.* has acquired *COYNCO PRODUCTS, INC.,* and will expand the facility for manufacture of shell and tube and air cooled heat exchangers. The operation will be known as *YUBA-TULSA CORP.*

▶ *ILLINOIS TESTING LABORATORIES, INC.* has changed its name to *ALNOR INSTRUMENT CO., DIV. OF ILLINOIS TESTING LABORATORIES, INC.*

▶ *COPELAND REFRIGERATION CORP.* stock has been listed on the New York and Detroit stock exchanges.

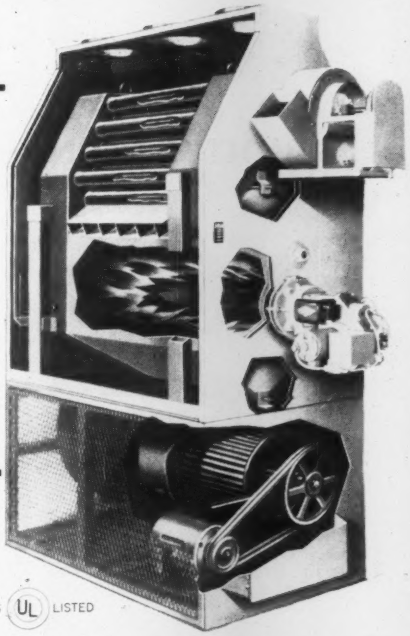
▶ *STERLING TRANSFORMER CORP.* has completed a three-fold expansion of its production facilities in Brooklyn, N.Y.

▶ *H. K. PORTER CO., INC.* has announced the acquisition of *ACIERIES & ATELIERS de CONSTRUCTION de MARPENT,* French producer of steel, railway cars, and other industrial products. Porter will operate the French firm for marketing both its own products and Porter products from the United States.

**arkos** . . . for quality engineering . . . performance . . . efficiency!

CHECK THESE IMPORTANT FEATURES ▼

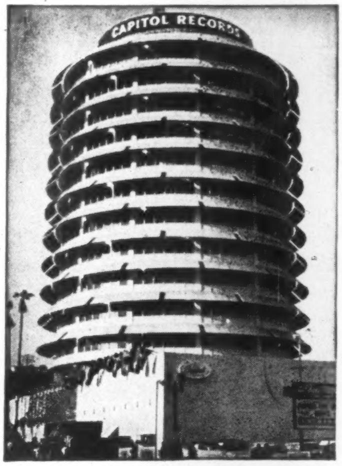
- ★ Diamond-shaped stainless steel combustion chamber with true floating four point suspension
- ★ NAFM certified blowers
- ★ Power-rated burner for gas, oil, or combination fuels
- ★ Steel radiation shield
- ★ Self aligning, permanently lubricated life-time roller bearings
- ★ Unitized welded structural steel construction throughout
- ★ Vibration eliminators on all suspended units
- ★ All controls in gasketed control cabinet
- ★ High CFM
- ★ Low blower RPM
- ★ Low blower motor horsepower
- ★ Wired, assembled and flame tested prior to shipment
- ★ Independent blower support
- ★ Ten year heat exchanger warranty
- ★ 80% guaranteed efficiency



**ARKOS Heaters provide dependable yet inexpensive means of heating plants, warehouses, enclosed docks, churches, schools, and are suitable for space heating, make-up air, and drying applications.**

Available for floor, horizontal and inverted mountings.
Capacities from 400,000 to 3,500,000 BTU/hr output.

**ARKOS Manufacturing Company**
7310 Woodward Avenue
Detroit 2, Michigan



CAPITOL RECORDS BLDG.
LOS ANGELES, CAL.

WELTON, BECKET & ASSOCIATES, ARCHITECTS-ENGINEERS, STATE PLUMBING & HEATING CO., MECHANICAL CONTRACTOR

*Capitalize on*

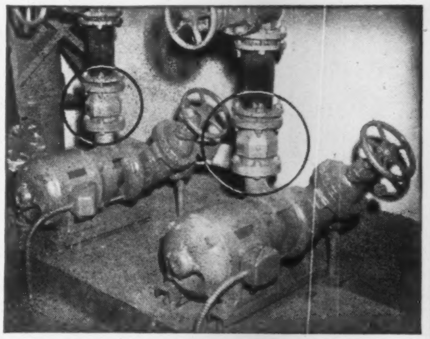
**MILLER Streamflow CHECK VALVES**

**Completely** Silences your piping system! CENTER-GUIDED, SHOCK PROOF, NOISELESS, ELIMINATES WATER HAMMER. FULL RADIAL FLOW. FACTORY MUTUAL LABORATORIES APPROVED.

SIZES 1" THROUGH 24".

FLANGED, ASA DRILLING, IBBM, CAST STEEL, ALL ALLOYS FOR ALL FLUIDS AND GASES.

CERTIFIED MINIMUM PRESSURE DROP CURVE AVAILABLE

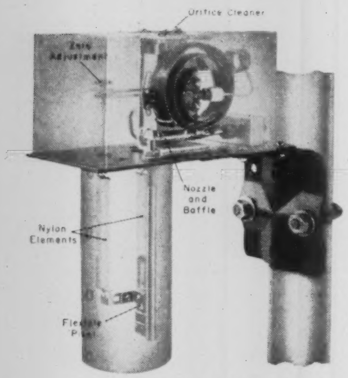


***Write for literature • Agents in Principal Cities***

**MILLER VALVE CO., INC.**
Pittsburgh 30, Pa.
Plant—1620 Pennsylvania Ave.

*New* FROM *Taylor*

**No. 207T RELATIVE HUMIDITY TRANSMITTER**



*Phantom View of Room Model*

**Simple.** A non-indicating, pneumatic, motion-balance transmitter, the No. 207T produces an air output pressure proportional to the relative humidity around the sensing elements, permitting a direct reading in the receiving instrument.

**Easy to adjust.** Zero setting can be checked by comparing the output with relative humidity determined by a wet and dry bulb hygrometer. Adjustment is by means of a knurled nut on the Bourdon spring take-off arm.

**Easy to maintain.** Nylon elements, nozzle-baffle system and Bourdon spring element are easily accessible; stainless steel nozzle simply removed for cleaning; finger-tight tubing connections.

*Write for*

**Bulletin 98338**

*Taylor Instrument Companies*
*Rochester, New York, and Toronto, Ontario*

*Taylor Instruments*
***MEAN ACCURACY FIRST***

## WHO'S WHAT . . .

***(New personnel, promotions)***

▶ *UNITED ELECTRIC CONTROLS CO.* — Robert Rando, director of materials and production.

▶ *CHASE BRASS & COPPER CO.* — David M. Andrews, director of production planning and control.

▶ *ARMSTRONG CORK CO.* — William Lawton, manager of engineering and maintenance purchasing.

▶ *KEASBEY & MATTISON CO.* — George Barge, vice president, finance, and member of board of directors; A. F. Humlhanz, treasurer; Emil F. Krynick, operations research analyst; John R. Wilson, plant engineer, plant No. 4.

▶ *ANSUL CHEMICAL CO.* — Robert W. Reinicke, vice president of operations.

▶ *CARRIER AIR CONDITIONING CO.* — Hermann C. Hoffmann, general manager, machinery and systems operation; William L. McGrath, general manager, unitary equipment operation; Allen W. Sherman, director of personnel; Theodore Skoglund, director of advertising and sales promotion.

▶ *CHRYSLER CORP., AIRTEMP DIV.* — Lee Epley, advertising manager.

▶ *THOR POWER TOOL CO.* — Gale C. Wicks, assistant to the president for liaison with the firm's Drying Systems Div.

▶ *HAVEG INDUSTRIES, INC.* — Dr. Ernest O. Ohsol, vice president in charge of chemical operations.

▶ *THE BABCOCK & WILCOX CO.* — John A. Menster, manager of welded tubing sales, Tubular Products Div.

▶ *FRICK CO.* — William F. Weir, manager of manufacturing planning; Arthur W. Bell, director of industrial relations.

▶ *JOHNS-MANVILLE CORP.* — M. W. Burleson, general sales manager for distributor sales, Industrial Insulations Div.

▶ *ROBERTSHAW-FULTON GRAYSON CONTROLS DIV.* — Richard D. Hall, manager, distributor sales.

## SPACE-SAVING EFFICIENCY & FLEXIBILITY

### with the Roberts-Gordon "CYCLO - JET"

Here's the hottest news in years for commercial and industrial heating! Roberts-Gordon's *new*, complete line of "Cyclo-Jet" power pressure burners achieves a unique concept of peak efficiency fuel combustion in a truly compact package. It's the all-new "Cyclo-Jet" burner head that does it!

- **Positive Combustion Air Control Insures Maximum Fuel Economy**
- **Uniform, Compact Flame Pattern over Wide Firing Range**
- **Completely Automatic Control System**
- **Gas, Oil or Dual Fuel Gas/Oil Models**
- **Capacities to 2,600,000 BTU's/hr. input**

Factory assembled and tested, the "Cyclo-Jet" Burner is a *complete* fuel burning device and control system. Combining high efficiency with great compactness, the new "Cyclo-Jet" Burner Head is extremely flexible and simple to install.

Unique design of burner head forces gas and air into combustion chamber with cyclonic turbulence. This gives compact flame configuration with resulting high heat release, facilitating firing of equipment normally presenting difficult combustion problems.

Accurate combustion air control with either fuel eliminates need for induced draft fan or tall chimney. Fixed firing rate, two-stage or fully modulating gas control systems are available. Dual gas/oil burners are designed for quick manual or automatic fuel changeover. Low-fire start and pre- and post-purge are optional. Totally enclosed control panel is standard. Panel lights indicate when controls are energized. Electronic-interrupted pilot control system gives safe, positive main flame supervision. Fully factory guaranteed.

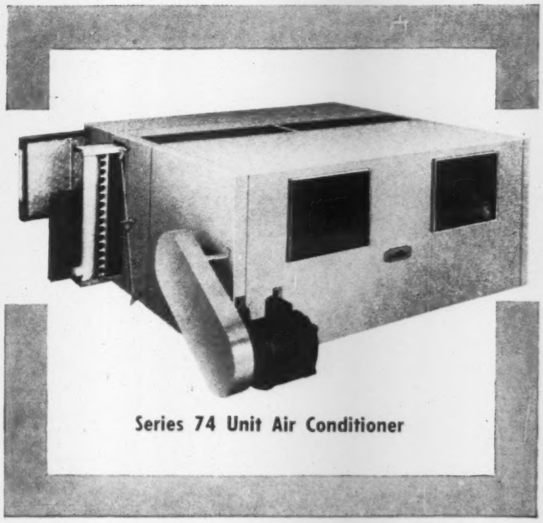
Cash In On the Profit Opportunities of the Revolutionary New "Cyclo-Jet" Power Pressure Burner Line NOW! Contact Your Roberts-Gordon Dealer or Write Us Direct.

ROBERTS GORDON

**ROBERTS-GORDON APPLIANCE CORP.**
**44 Central Ave., Dept. HP, Buffalo 6, N.Y.**
*In Canada — Grimsby, Ontario*

**USAIRCO**

## 40 years experience in air handling units



Series 74 Unit Air Conditioner

## RUGGED CONSTRUCTION

**Built for Efficient Performance, Long Life and Trouble-Free Operation**

WRITE FOR PRODUCT BULLETIN 74

**United States Air Conditioning Corporation**
**Delaware, Ohio**

## WHO'S WHAT

*Continued*

- *BENDIX-WESTINGHOUSE CO.* — Jack F. Fritchman, engineering manager of compressor development for Evansville division.

- *PITTSBURGH CHEMICAL CO.* — Gradon F. Willard, production manager, Activated Carbon division.

- *STILES-KARLSONITE CORP.* — Frank A. Cianflone, vice president and general manager.

- *THE BLACK AND DECKER MFG. CO.* — under new alignment of top management: Robert D. Black, chairman of the board, chairman of the executive committee, and director, plus chief executive officer; Alonzo G. Decker, Jr., president and director; W. Griffin Morrel, executive vice president and director.

- *AIR COMFORT CORP.* — D. A. Forberg, president; J. J. Smerz, executive vice president and in charge of sales.

- *YALE & TOWNE MFG. CO.* — Gordon Patterson, president and director. He was previously president of *SQUARE D CO.*

- *DUNHAM-BUSH, INC.* — George R. Williams, assistant export manager.

- *TUBE TURNS PLASTICS, INC.* — J. P. Knopf, secretary-treasurer of the firm, has been elected vice president.

- *FLUID CONTROLS INSTITUTE, INC.* — officers elected at Spring meeting: president: Fred E. Weldon, General Controls; first vice president: Robert F. McCormick, Automatic Switch Co.; second vice president: Eric A. Bianchi, Worthington Corp.; treasurer: Paul K. Rogers, Jr., The Skinner Chuck Co.; corporate secretary: Samuel J. Reid, Barnes & Jones, Inc.; executive secretary: E. R. Rath.

- *AMERICAN SOCIETY FOR TESTING MATERIALS* — Raymond E. Hess, acting executive secretary; Robert J. Painter, consultant to the executive secretary and treasurer. Dr. Allan Bates, vice president of Portland Cement Assn. was elected to ASTM presidency at recent annual meeting.

- *CLAYTON MARK & CO.* — James Oakley, director of manufacturing; Carl V. Schroeder, purchasing agent; William J. Dickman, assistant sales manager, union division.

WEBCO-RAY

**HUSKY**

**Packaged Boilers**

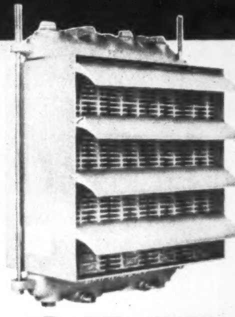
**For the first time... Full Modulation at low cost**

New HUSKY Series packaged boilers are designed to deliver maximum efficiency and economy in the 20 to 125 boiler horsepower range. Models to burn light oil, natural gas, or combination gas-oil. Exclusive full modulation for either oil or gas provides steady performance at any load requirement. HUSKY is completely factory packaged making field installation fast and simple. Webco-Ray factory trained local representatives provide immediate service and local parts supply. Write for new HUSKY catalog and the name of your local Webco-Ray representative.

**WESTERN BOILER COMPANY**
47 Rousseau Street, San Francisco 12, California
4024 Filbert Street, Philadelphia 4, Pennsylvania

**GRID's got to be good!**

ABBOTT LABORATORIES
ALLEGHENY LUDLUM
MERCK & CO., INC.
PENICK & FORD LTD.
UNITED STATES STEEL
GEO. A. HORMEL CO.
DIAMOND ALKALI CO.
GENERAL MOTORS
JONES & LAUGHLIN
DOW CHEMICAL CO.
AMERICAN BRASS CO.
JOHNS-MANVILLE
A.T. & S.F.R.R. CO.



**The best guarantee any product can have is its users.**

**LOOK** at the plants that depend upon

**GRID** ▶ UNIT HEATERS
BLAST HEATERS
RADIATORS

for a trouble-free, low maintenance cost heating system - One that will serve without service - Installations made in 1929 are still operating without need for repairs. GRID'S design and construction makes the difference!

**GRID** Cast Iron Construction resists corrosion externally from acid fumes and internally from electrolysis. No leaking from rotted cores.

**GRID** one-piece cast iron heating sections and headers are leak-proof on steam pressure up to 250 p.s.i. 450° temperature. Smaller steam lines cost less.

**GRID** heating sections with widely spaced fins cast integral with steam chambers are easy to clean - Will not "mat" on air intake side.

**GRID** design develops low outlet temperatures and, with proper fan volumes, delivers warm, comfortable air to floor - No wasted heat at ceiling.

Get complete information on a GRID System for your plant. Write for catalog #956 GRID CAST IRON STEAM HEAT TRANSFER SURFACE.

BAKELITE CO. Representatives in CELOTEX CORP.
B & O R.R. principal cities CMSTPP&P RR
EVERETT PULP & PAPER CO. VICTOR CHEMICAL WORKS
GENERAL ANALINE & GENERAL CHEMICAL DIV. CUDAHY PACKING CO.
AMERICAN CHAIN & CABLE SWIFT & CO. WHEELING STEEL CORPORATION
AMERICAN CYANAMID CO. H. J. HEINZ CO. INTERNATIONAL SHOE CO.
ARMCO STEEL CORP. CONSOLIDATED MINING & SMELTING CO., LTD.
ARMOUR & CO. SINCLAIR REFINING CO. CARNEGIE ILLINOIS STEEL CO.
AMERICAN STEEL & WIRE CO. COLUMBIA SOUTHERN CHEMICAL CORP.
ANACONDA COPPER MINING CO. OLIN-MATHIESON CHEMICAL CORP.
ANSUL CHEMICAL CO. UNITED ELECTRIC COAL CO. NATIONAL LEAD CO.
ARMSTRONG CORK CO. ALLIED CHEM. & DYE CORP. NATIONAL ANILINE
ALLIS-CHALMERS MFG. CO. SHARPLES CHEMICALS NAUGATUCK CHEMICAL
AMERICAN MACH. & FOUNDRY CO. WEST VIRGINIA PULP & PAPER CO.
AMERICAN RADIATOR & STD. SAN. LITHIUM CORP. MORTON SALT CO.
ANCHOR HOCKING GLASS CORP. HERCULES POWDER FALK CORPORATION
GENERAL FOODS CORPORATION PENNSYLVANIA SALT MFG. CO.
GENERAL ELECTRIC CO. U. S. RUBBER CO. PHILLIPS PETROLEUM CO.
INLAND STEEL GREAT NORTHERN RAILWAY WASHINGTON TERMINAL CO.
ILLINOIS CENTRAL R.R. CO. WESTINGHOUSE UNION CARBIDE & CARBON
MINNESOTA MINING & MFG. CO. E. I. DuPONT de NEMOURS INC.
NEW YORK CENTRAL R.R. ELECTRIC AUTO LITE CO. MASONITE CORP.
CANADIAN PACIFIC RWY. CO. YOUNGSTOWN SHEET & TUBE CO.
KRAFT FOODS GENERAL TIRE & RUBBER CO. INTERNATIONAL PAPER CO.
CHAIN BELT CO. A. O. SMITH CORPORATION BETHLEHEM STEEL CORP.
CHESAPEAKE & OHIO R.R MONSANTO CHEMICAL CO. BENZOL PRODUCTS
MAINE CENTRAL R.R. CO. NORTHERN PACIFIC R.R. CO. BENDIX CORP.
CHICAGO NORTH WESTERN R.R. STANDARD OIL CO. FORD MOTOR CO.
CHRYSLER CORP. WILLPUTTE COKE OVEN DIV. DIAMOND ALAKALI CO.
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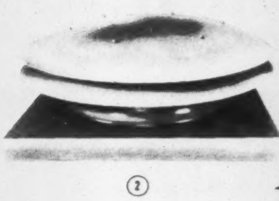

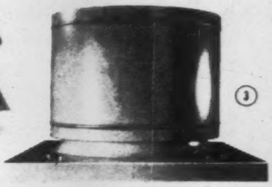

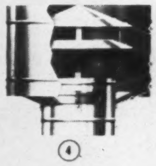

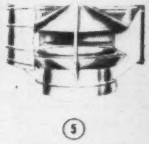

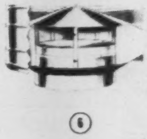

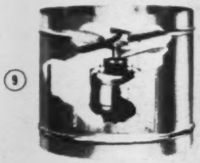

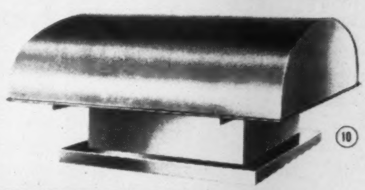

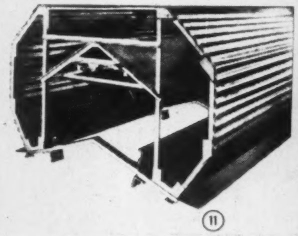

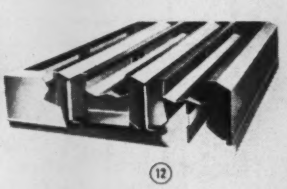

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Complete Catalog in Sweets. Member Air Moving and Conditioning Assoc., Inc.

## WHO'S WHAT

*Continued*

▶ *ORR & SEMBOWER, INC.*, — Richard W. Lamp, manager of production.

▶ *MINNEAPOLIS-HONEYWELL REGULATOR CO.* — Dr. Van W. Bearinger, director of research; Dr. John N. Dempsey and Edward E. Rexer, assistant directors.

▶ *ALLIED METAL HOSE CO.* — Fredric R. Cahn, director of sales.

▶ *SOLAR AIRCRAFT CO.* — Robin Schmidt, director of public relations and advertising.

▶ *WORTHINGTON CORP.* — P. L. McManus, director, marketing services group; W. J. Wallace, assistant general sales manager, marketing division.

▶ *RESEARCH-COTTRELL, INC.* — Dr. Philip Cooperman, director of research and development.

▶ *ARNO ADHESIVE TAPES, INC.* — Milton H. Kemp, director of research, has been elected vice president.

▶ *HI-PRESS AIR CONDITIONING OF AMERICA, INC.* — Robert H. Hood, vice president in charge of sales; I. B. Secord, national sales manager, commercial and industrial division.

▶ *AMERICAN-STANDARD DETROIT CONTROLS DIV.* — James A. Kozel, manager of product engineering for heating, air conditioning, industrial, other products.

▶ *AMERICAN GAS ASSOCIATION* — nominated for president: Lester T. Potter, president of Lone Star Gas Co., Dallas; for first vice president: Edward H. Smoker, president of The United Gas Improvement Co., Philadelphia; for second vice president: John E. Heyke, president of The Brooklyn Union Gas Co., Brooklyn; for treasurer: Charles H. Mann, treasurer of The Columbia Gas System, Inc., New York. Elections will be held at the annual convention, October 12.

▶ *ANEMOSTAT CORP. OF AMERICA* — William Waeldner, director of research.

▶ *INSTRUMENT SOCIETY OF AMERICA* — Ira S. French, director of public relations.

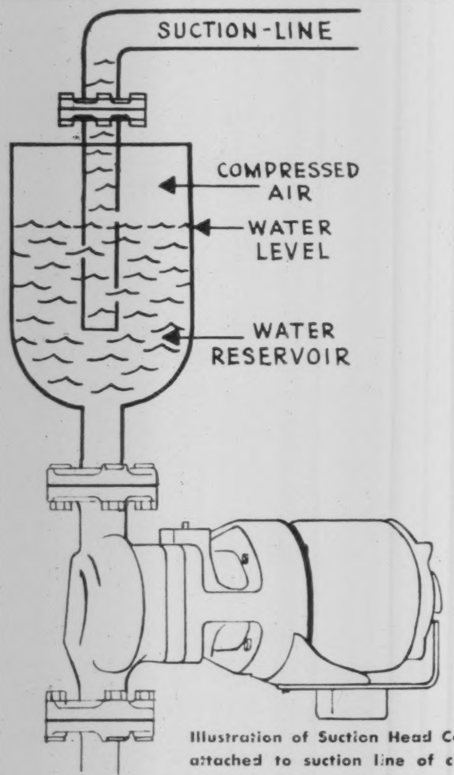

Illustration of Suction Head Compensator attached to suction line of circulator in vertical position.

THE NEW COBRA
SUCTION HEAD COMPENSATOR
FOR ALL HOT WATER HEATING SYSTEMS

The Suction Head Compensator is a forged steel chamber with the top nozzle extending into the chamber, two inches from the bottom. The Compensator acts as a reservoir of readily available water or liquid right above the circulator, which is cushioned by compressed air. When the circulator starts it gradually draws its initial load of water or liquid from the Compensator, allowing a normal and quiet circulation throughout the system. This prevents excessive pressure changes, noisy surges at the impeller and partial vacuums. For presently installed systems the Suction Head Compensator can correct problems and complaints due to surges and other circulation problems.

For new installations the Suction Head Compensator assures better operation with no costly call-backs as no maintenance is required.

Available from your local supply house, or if it is not available at your supply house now, write, giving us the name of your supply house or dealer. Due to initial demand, delivery will be two to three weeks.

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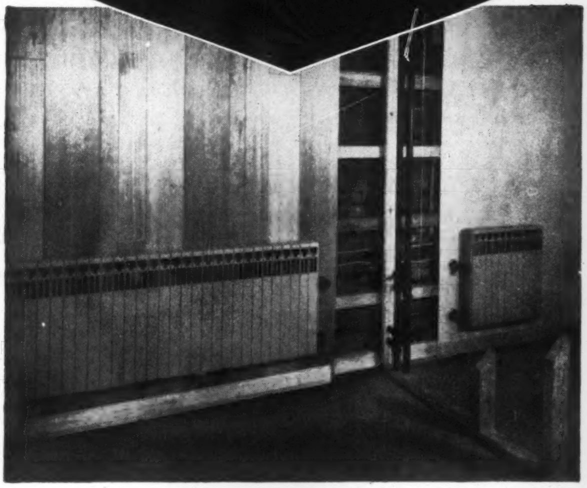
Phone — Hartford AD-3-1231

## REDUCE piping costs ... SPEED installation



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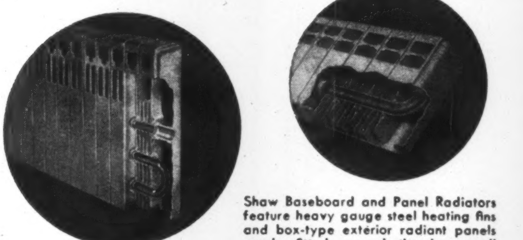
## SHAW Radiators

Only Shaw, of all modern radiators, offers *same end* as well as opposite end tapping. Same end tapping has a place in almost every piping layout, and its use invariably means less piping materials, simplified pipe fitting.

Important savings in installation time are made with *any* Shaw model, regardless of tapping arrangement. Shaw units are compact, fully self-contained assemblies only 3" thick, easy to handle and mount. There are no dampers, or separate housings to fit and install.

Shaw Radiators distribute both radiant and convected heat in unvarying, health-guarding proportions that create natural thermal comfort in a room. They use either hot water or steam up to 150 psi. Write today for free literature on both panel and baseboard models.



Shaw Baseboard and Panel Radiators feature heavy gauge steel heating fins and box-type exterior radiant panels snugly fitted around the heavywall copper tubing. Tubing is then expanded slightly by 3750# hydraulic pressure to hold all components as a rigid, self-contained unit. The tight metal-to-metal bond assures rigidity and full heat conduction.

**SHAW-PERKINS**
**MANUFACTURING COMPANY**
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DIAMOND GRILLES

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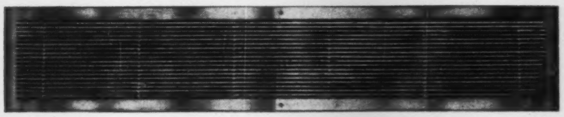

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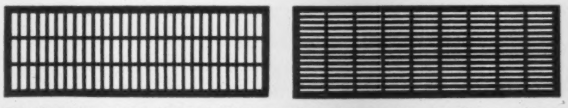
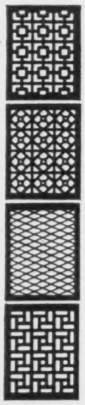
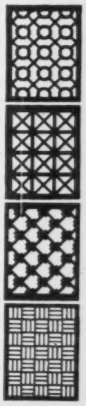
. . . meet the current demand for a very strong bar-type grille which provides more than the usual percentage of open area and is suitable, in general appearance, for use with practically any modern style of interior design. Specified by leading engineers and architects for Schools, Colleges, Hospitals, Ocean Liners, Sports Arenas, etc. Custom Built (no standard sizes) in any specified rectangular size or shape — All Steel or All Aluminum — for either direct or deflected air flow. Write for Bulletin 43.



## DIAMOND ARCHITECTURAL GRILLES



. . . are stamped from Steel, Aluminum, Bronze or any other commercial metal; in a wide variety of artistic designs, in any desired thickness up to one-quarter inch, with correspondingly LARGE unit openings. Widely used, for nearly half a century, in America's finest buildings, they have proved practically indestructible — standing up for years against any probable amount of rough usage. Bulletin 41 illustrates and describes a number of popular designs and applications. Catalog 36 (100 pages) contains actual-size illustrations of ALL Diamond Grille designs, together with complete working data. Write for either or both — no charge or obligation.



**DIAMOND MANUFACTURING CO.**
**Box 41 WYOMING PENNA.**
(Wilkes-Barre Area)

## WHO'S WHAT

*Continued*

▶ *YORK-SHIPLEY, INC.* — Frank E. Young, general sales manager, Jackson & Church Division.

▶ *ARCOS CORP.* — James E. Norcross to board of directors.

▶ *YORK DIV., BORG-WARNER CORP.* — Caryl C. Lewis, former vice president of Schick, Inc., staff assistant to president Joseph B. Elliott.

▶ *CRS INDUSTRIES, INC.* — William C. McMichael, director of sales.

▶ *CORNING GLASS WORKS* — Arthur W. Weber, vice president, named director of manufacturing services; Dr. Ben Allen, director of engineering.

▶ *CRANE CO., INDUSTRIAL PRODUCTS GROUP* — R. E. Kenton, advertising manager, K. H. Johnson, sales promotion manager.

▶ *WALTON LABORATORIES, INC.* — Edward Lauster, plant manager at Irvington, N.Y., facility.

▶ *AMERICAN AIR FILTER CO., INC.* — Charles S. Stock, manager of central marketing; Frank K. Platt, manager, school air systems division; A. B. Ullrich, Jr., manager of engineered air systems division.

▶ *H. K. PORTER CO., INC.* — W. D. Fullerton, general manager, Forge & Fittings Division.

▶ *CURTIS MFG. CO.* — Howard E. Smith, advertising manager.

▶ *ALBERT KAHN ASSOCIATED ARCHITECTS AND ENGINEERS, INC.* — John Haro, A.I.A., chief architectural designer.

▶ *AMERICAN STANDARD INDUSTRIAL DIVISION* — A. F. L. Anderson, director, value analysis.

▶ *MIDWEST PIPING CO., INC.* — Hugh W. Baird to board of directors.

▶ *COORDINATING COMMITTEE* — for mechanical specialty contractors associations of Chicago, new executive secretary: Henry J. Couch, who is executive secretary of the Ventilating and Air Conditioning Contractors Association of Chicago.

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the **weil**
**LOW RETURN**
**CONDENSATE PUMP**

with
- **LOW RETURN CONNECTION**
- **CAST IRON RECEIVER**
- **1750 RPM MOTORS**

| UNIT NO. | SQ. FT. E.D.R. | CAP. G.P.M. | H. P. | PUMP DISCH. | HEIGHT OF RETURN | RETURN INLET |
|---|---|---|---|---|---|---|
| TVC 19 | 750 | 1.5 | 1/4 | 1" | 6 7/8" | 2" |
| TVC 23 | 1000 | 1.5 | 1/4 | 1" | 6 7/8" | 2" |
| TVC 29 | 2000 | 3.0 | 1/4 | 1" | 6 7/8" | 2" |
| TVC 35 | 4000 | 6.0 | 1/4 | 1" | 6 7/8" | 2" |
| TVC 41 | 6000 | 9.0 | 1/2 | 1" | 6 7/8" | 2" |

Discharge pressure: 20 lbs. P.S.I.

Low speed (1750 RPM) assures long life and the float switch control built into this unit means trouble-free service. See Sweet's Catalog or send for Bulletin TVC-300 for full specifications and pumps with capacities to 15,000 sq. ft. EDR.

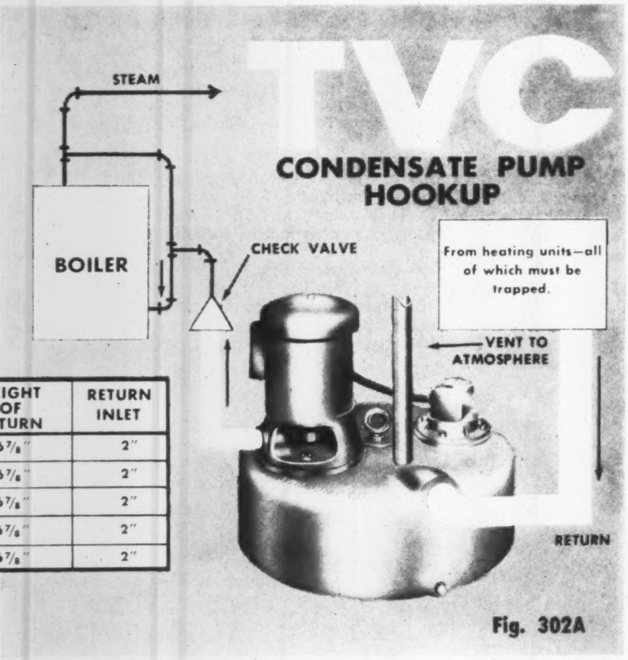

Fig. 302A

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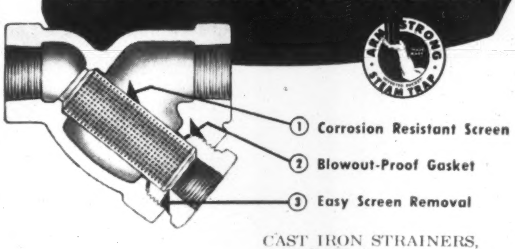

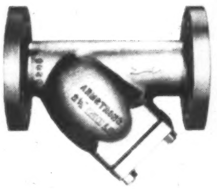

CAST IRON STRAINERS,
250 lb. Design
Screwed Connections—¼″-3″
Flanged, 125 or 250 lbs.—2″-6″

CAST CARBON STEEL STRAINERS, 600 lbs., at 750° F
Screwed or Socket Weld Connections—½″-3″
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CHROME MOLY WC6 STRAINERS, 900 lbs., at 900° F
Screwed or Socket Weld Connections—½″-2″

Also available in Type 316 stainless steel and cast bronze.

*Your Armstrong Representative can give you the details. Call or write today—ask for Bulletin 605.*

*Satisfaction Guaranteed*

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**ARMSTRONG Y-TYPE PIPE STRAINERS**

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If you are after precise, dependable temperature indication, take a close look at these high-quality features of Trerice dial thermometers!

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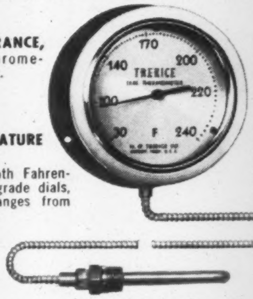
**WIDE TEMPERATURE RANGES,** available in both Fahrenheit and Centigrade dials, temperature ranges from -100° to 1000° F.



**EASY TO READ,** modern aluminum dial, large figures.

**WIDE VARIETY,** dial available in 2″, 2½″, 3½″, 4½″, 6″, 8½″ and 12″ diameters with mercury, vapor, gas, solid liquid or bi-metal actuation.

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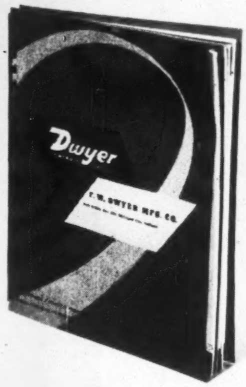
**..tells where to use them.. ..WHY and HOW!**



*Illustrates* instruments and gages...*diagrams* their installation and on-the-job use... *charts* valuable performance data.

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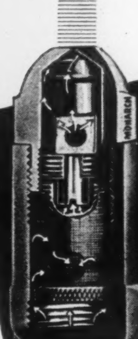
## Monarch NOZZLES For HUMIDIFYING



**Monarch Brass F-80 Air Conditioning Nozzles (or ¼″ male one-piece H-261 style) produce the finest possible breakup of small capacities with low direct pressure only. No air required.**

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**Available in 25 different capacity sizes from .57 gph upwards, all Brass construction with 120 mesh Monel screen strainers.**

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THE PERFECT SEALER
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THE PLASTIC GASKET-JOINT CEMENT-ADHESIVE

Makes tight joints in piping, tubing and hose connections.
Withstands heat up to 350°F.
Impervious to oil, gasoline, kerosene, water, steam and glycol.
2 oz. or 6 oz. tube, quarts and gallons.

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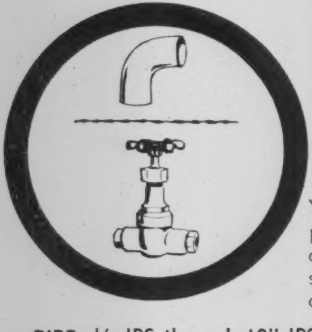
**Stainless pipe and fittings**



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# MEETINGS & CONVENTIONS

*SEPT.* 14-17—*Second Annual Southeastern Maintenance and Engineering Show.* Sponsored by North Carolina chapters, American Institute of Plant Engineers, American Welding Society, and Maintenance Council of North Carolina Motor Carriers Assoc. State Fair Arena, Raleigh, N.C. Information: John Harden Associates, P.O. Box 3173, Greensboro, N.C.

*SEPT.* 26-29—*American Welding Society Fall Meeting.* Penn-Sheraton Hotel, Pittsburgh, Pa. Information: American Welding Society, 33 West 39th St., New York 18, N.Y.

*SEPT.* 26-30—*Instrument Society of America, Fall Instrument-Automation Conference and Exhibit, and* 15th *Annual Meeting.* New York Coliseum. Information: W. F. Minnick, Jr., Director of Public Relations, Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

*OCT.* 12-15—*Cast Bronze Bearing Institute and Non-Ferrous Founders' Society annual meetings.* Grove Park Inn, Asheville, N.C. Information: Non-Ferrous Founders' Society, 1604 Chicago Ave., Evanston, Ill.

*OCT.* 17-21—*48th Annual National Safety Congress.* Industrial safety sessions, Conrad Hilton, Pick-Congress, Sheraton Towers, Morrison, and La Salle hotels, Chicago. Information: R. L. Forney, secretary, National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

*NOV.* 28-*DEC.* 2—*24th National Exposition of Power and Mechanical Engineering.* Under auspices of the American Society of Mechanical Engineers. New York Coliseum. Information: International Exposition Co., Inc., 480 Lexington Ave., New York 17, N.Y.

*DEC.* 12-15 — *Industrial Building Exposition and Congress.* New York Coliseum. Information: Clapp & Poliak, Inc., Management, 341 Madison Ave., New York 17, N.Y.

## 1961

*JAN.* 23-26 — *National Plant Maintenance & Engineering Show.* International Amphitheater, Chi-

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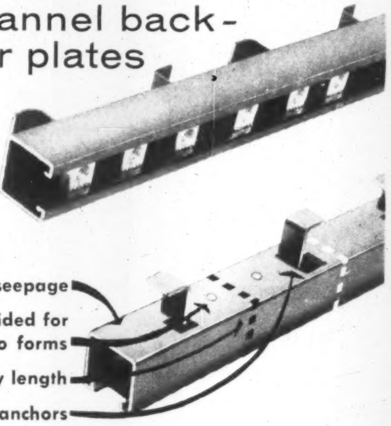
Solid channel back-
No cover plates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Knockouts provided for nailing to forms
Can be cut to any length
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Now available in various sizes and weights. Spot inserts, rods, hardware also in stock. For specifications and complete information write for literature today.

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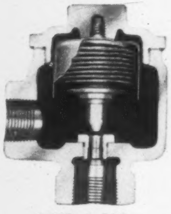
## THERMOSTATIC STEAM TRAPS

FOR MAXIMUM EFFICIENCY CHOOSE FROM THIS LINE OF RIGGIO THERMOSTATIC STEAM TRAPS

For pressures from Vacuum to 200 lbs.
Bronze Construction
½", ¾", 1"



TYPE A-200
Freeze-Proof

For pressures from Vacuum to 250 lbs.
Semi-steel Construction
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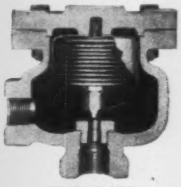

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**Simple**

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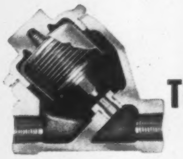
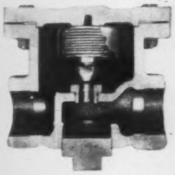


TYPE Y-200



TYPE B-250

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**Heating, Piping & Air Conditioning January issue which will contain our directory section**

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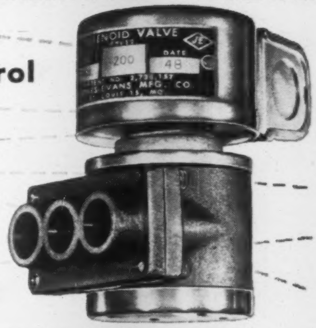
**for flow control of hot or chilled water with fan-coil units**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## MEETINGS & CONVENTIONS
*Continued*

cago. Information: Clapp & Poliak, Inc., Management, 341 Madison Ave., New York 17, N.Y.

*FEB. 13-16 — American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., semi-annual meeting.* Conrad Hilton Hotel, Chicago, Ill. Information: ASHRAE, 234 Fifth Ave., New York 1, N.Y.

*FEB. 13-16 — International Heating and Air Conditioning Exposition.* International Amphitheater, Chicago, Ill. Information: E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N.Y.

*MARCH 27-31 — Third National Symposium on Temperature — Its Measurement and Control in Science and Industry.* Sponsored by American Institute of Physics, Instrument Society of America, and National Bureau of Standards. Columbus, Ohio. Information: W. R. Tilley, National Bureau of Standards, Washington, D.C.

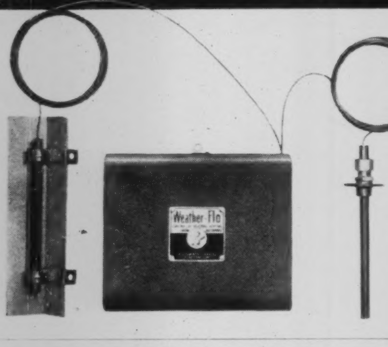
## NEW BOOKS & REPORTS...

*Thermal Engineering* — by Harry L. Solberg, Orville C. Cromer, and Albert R. Spalding. A revision and extension of *Elementary Heat Power* by the same authors. 649 pp. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. $9.50.

*Mechanical Properties of Structural Materials at Low Temperatures; A Compilation from the Literature* — by R. Michael McClintock and Hugh P. Gibbons. Graphic presentation of tensile strength, yield strength, tensile elongation, and impact energy of approx. 200 metallic and nonmetallic materials at functions of temperature between 4 and 300 K. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. $1.50.

*Making Better Plastic Welds* — by Donald W. Thomas. Instruction book on welding modern structural plastics. 56 pp. Laramy Products Co., Beechwood St. and Route 3A, Cohasset, Mass. $1.00

*Beta-Ray Gauges for Gas Density Measurements* — by B. W. Schumacher. Engineering data for beta-ray gauges or other electron probes working on the attenuation principle for measuring gas densities. 19 pp., 8 Fig. Ontario Research Foundation, 43 Queen's Park Cres., Toronto, Ontario, Canada.



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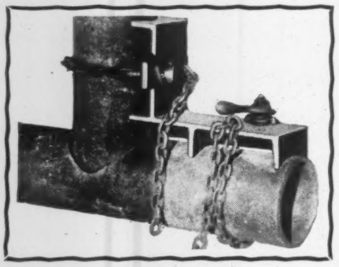

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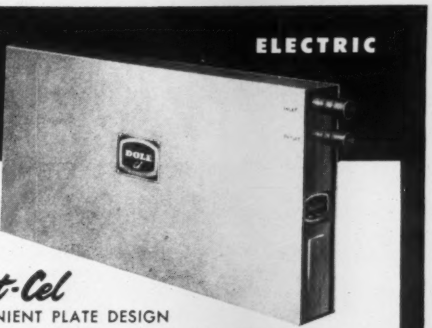

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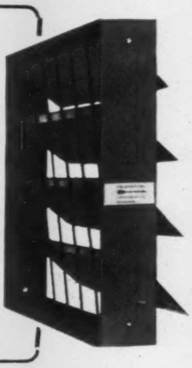

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**WANTED: Sales Manager Nationwide for specialty** mechanical line with triple A company. Must be engineer with experience in airflow products. Willing to travel. Present resident eastern seaboard. Send resume Key 1487A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

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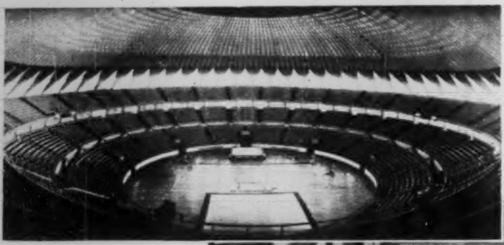
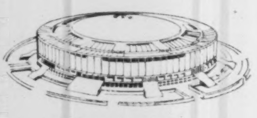
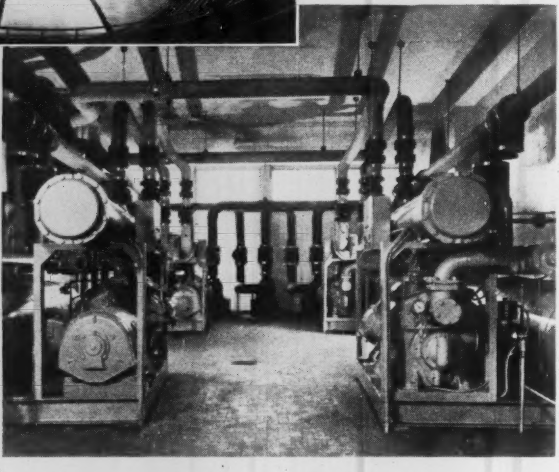
# Olympic Sports Palace in Rome Cooled by Vilter Refrigeration



Interior view of the beautiful Sports Palace (Palazzetto dello Sport) with seating capacity for 15,000, conceived by Annibale Vitellozzi and built by Pier Luigi Nervi. Boxing, basketball and fencing are among the events held here.



Exterior view of Coni Sports Palace.



View of the four separate Refrigerant 22 water chilling units installed in the 1960 Olympics Coni Sports Palace in Rome. These units each incorporate a Vilter 8-cylinder VMC compressor.

● Among the handsome architecture found at the 1960 Olympics in Rome is the small Palazzetto dello Sport, an all-weather sports palace built to seat 15,000 spectators. This inspiration in modern concrete form is matched by the latest innovations in air conditioning to provide comfort for athletes and fans alike.

The cooling system, custom-designed by Vilter's Italian distributor, Dell'Orto Chieregatti, provides 1,300 tons of refrigeration capacity, of which 450 tons is produced by a central system, and the remaining capacity is supplied by well water. Four self-contained water chilling units are installed in the central refrigeration station. Each chilling unit has a Vilter 8-cylinder VMC Refrigerant 22 Compressor.

This is another example of the world-wide acceptance of Vilter refrigeration equipment. The dependable performance of Vilter VMC compressors is the result of tireless engineering improvements: built-in capacity reduction, precision manufacturing techniques, painstaking inspection, careful assembly, and factory run-in tests.

Among the champions at the Olympics, Vilter compressors deserve a gold medal in their own field for efficient, reliable operation. Enjoy trouble-free Vilter equipment in your installation. Write today for helpful counsel about your air conditioning and refrigeration problems.

**Sold and installed by Vilter Distributor, SPA Dell 'Orto Chieregatti, Milan, Italy**

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refrigeration
air conditioning

**The Vilter Manufacturing Company**
**Milwaukee 7, Wisconsin**
Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.

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FREON COMPRESSORS

**Write for Bulletin 820 to**
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**2217 South First Street**
**Milwaukee 7, Wisconsin**

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*Incorporated 1917*

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3 Heating Cooling Acoustical

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*Architectural Products Division*

**749 East Park Avenue, Libertyville, Ill.**

*The*
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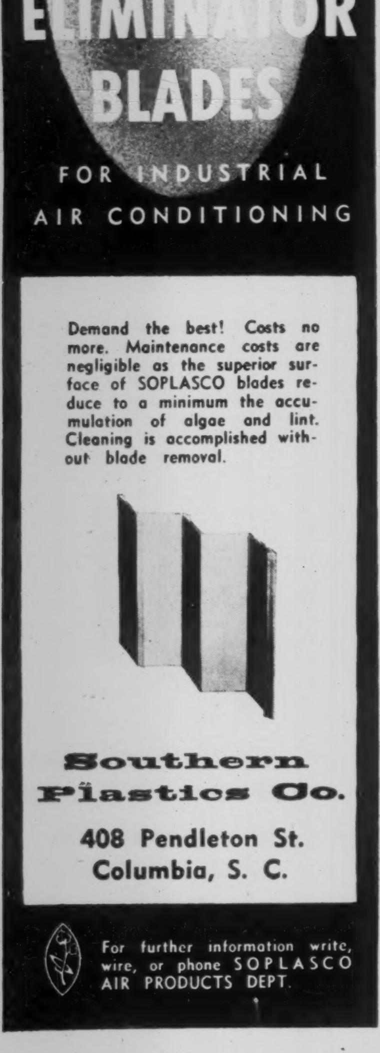
**3-WAY**
**FUNCTIONAL CEILING**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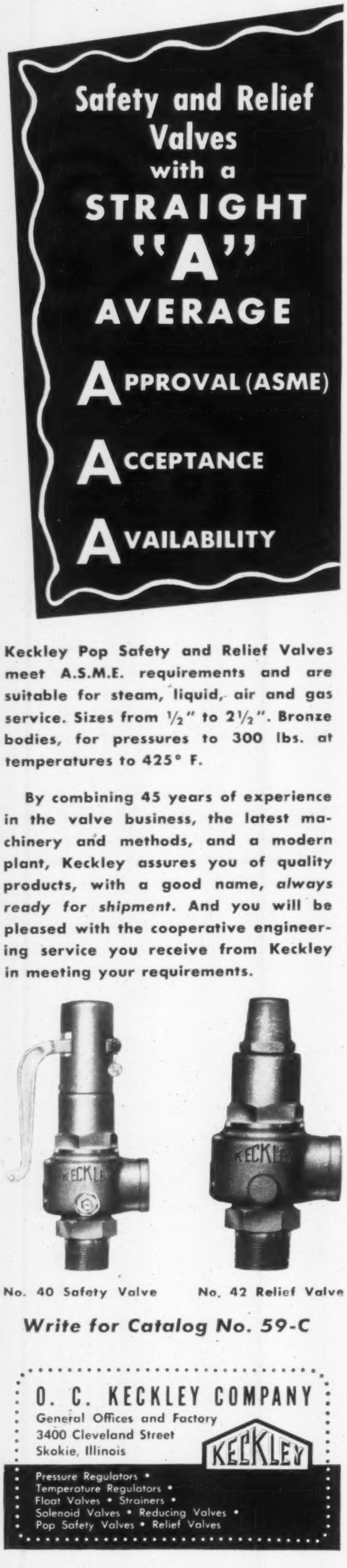
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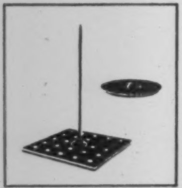
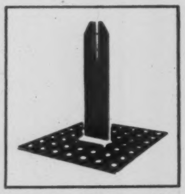
Use Miracle Surface Anchors, bonded with Miracle Anchor Adhesives, to provide firm support for block, board, or blanket type insulation. Eliminates drilling and welding. You save man hours, cut costs way down.



Use Spindle Anchors for bonding fibrous glass batts, mineral wool to ducts, walls, ceilings. Lock washer holds insulation firmly in place.



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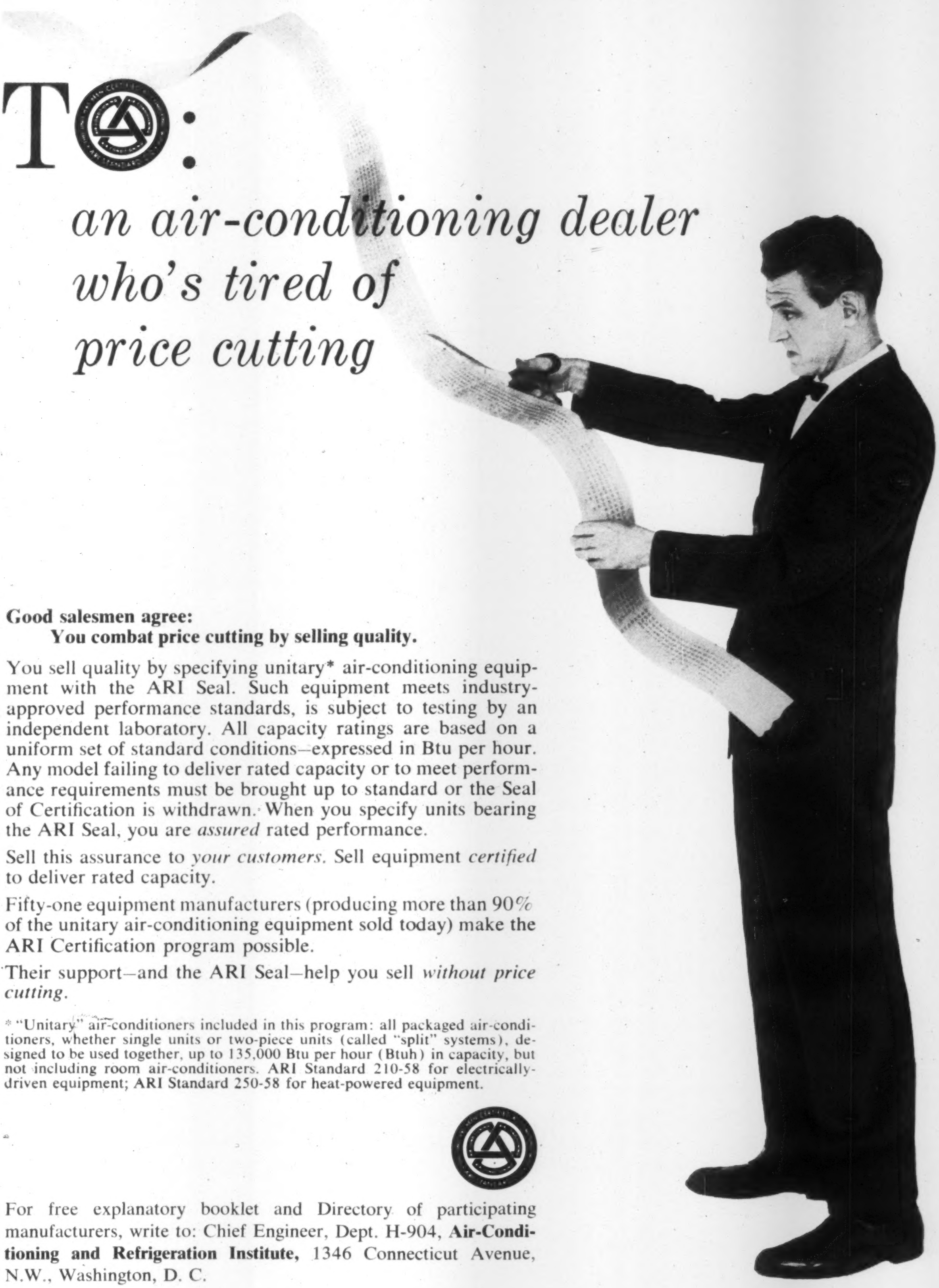

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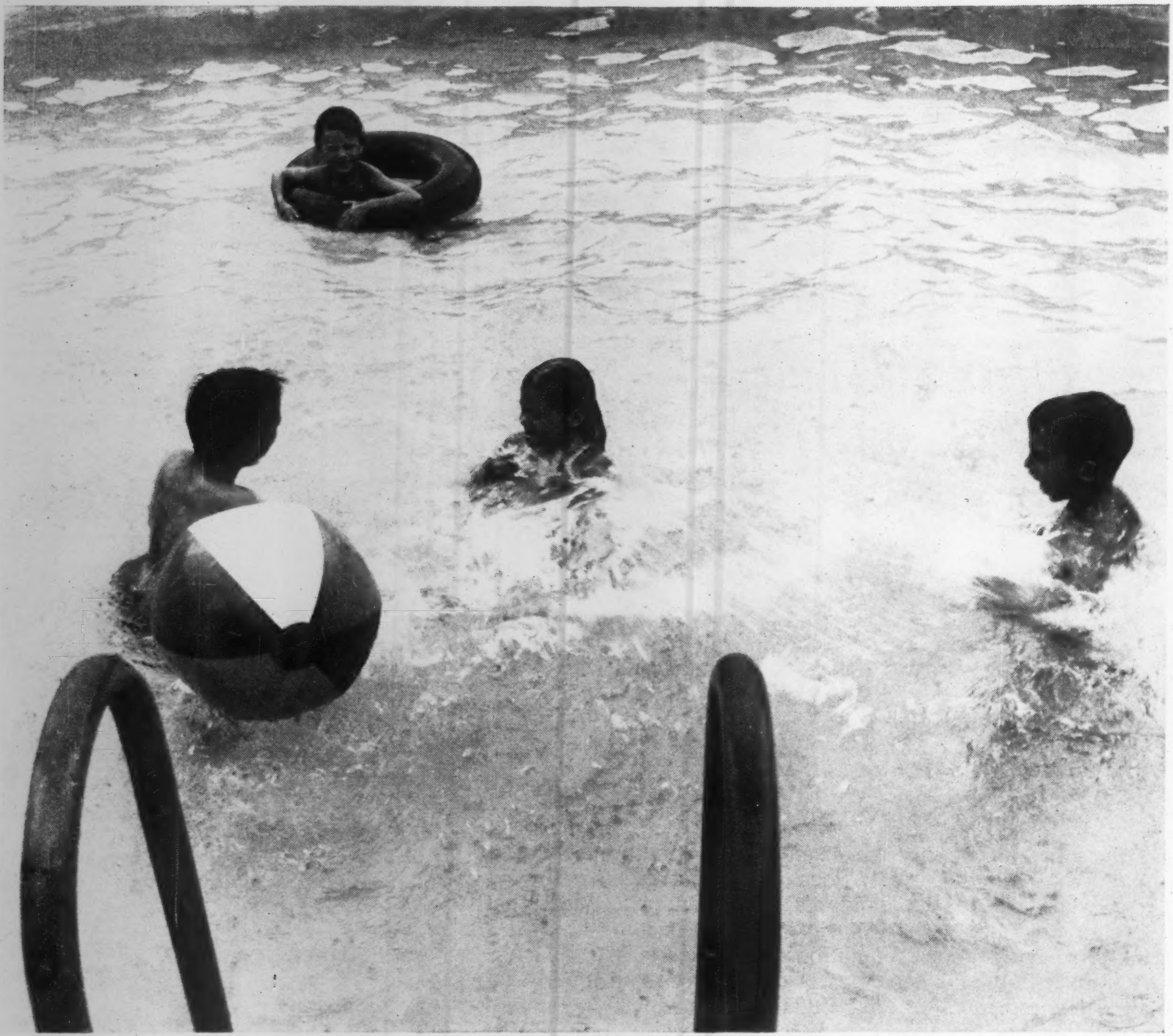
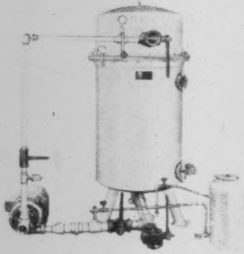


# here's why leading engineers specify Bruner pool filters:



**exclusive features:** Bruner's plastic disc core septum, "Air Bump" and "Air-Vac" systems add to the life of the filter, increase filter run, and speed cleaning operations. All three are Bruner exclusives.

**proven quality:** Bruner pool filters have been field tested for years under all water conditions, are backed by Bruner's reputation for dependability.

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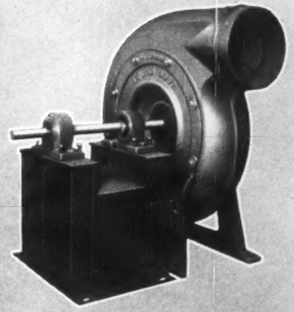
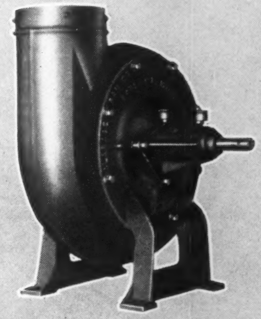


**ARRANGEMENT 1**



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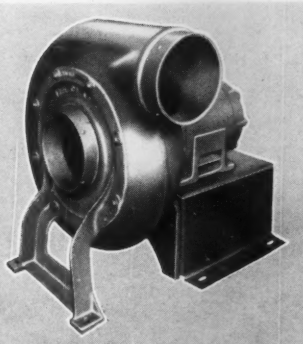

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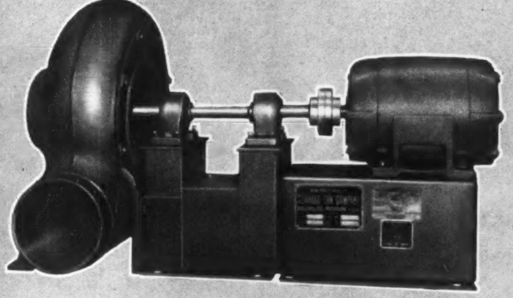

**ARRANGEMENT 8**

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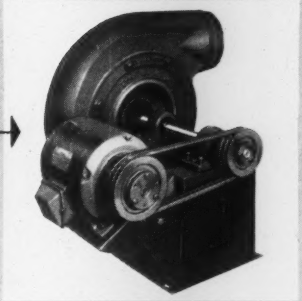
**ADDITION**



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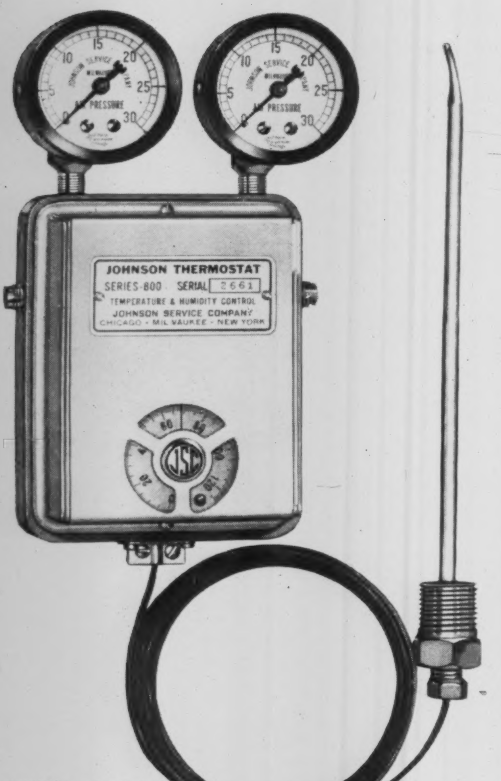
# JOHNSON SERIES T-800 THERMOSTATS

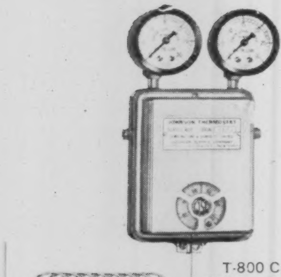
## FOR CONTROL OF AIR, STEAM, AND LIQUIDS



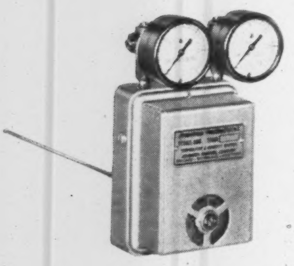
T-800 Remote Bulb Capillary Thermostat for Air, Steam, and Liquids.

- Series T-800 thermostats are designed for air conditioning, heating, ventilating, and industrial applications requiring accurate control at low sensitivities. They are widely used for the control of temperatures in air ducts or chambers, in tanks, and in pipes.
- Choice of elements:
  1. Liquid filled capillary with remote bulb. Standard temperature range from -30F to 300F. Fully compensated stainless steel capillaries available from 8 to 85 feet. Non-compensated copper capillaries furnished in 4 and 6 ft. lengths. Also available with 8-ft. averaging bulb.
  2. Rigid stem liquid filled immersion element. Temperature range from -30F to 300F.
  3. Rigid stem liquid filled insertion element. Temperature range from -30F to 300F.
- All elements are fully interchangeable.
- Remote bulb may be located at any point above or below thermostat.
- Proportional or two-position action.
- Direct or reverse acting. Simple change of pivots converts from direct to reverse acting.
- Sensitivity or differential: from ⅛ to 5 psi per degree F; 2 to 30 degrees F.
- Uniform sensitivity and dial graduations over entire range of operation.
- Used as standard thermostat and as a master controller for readjusting the control setting of a submaster thermostat.

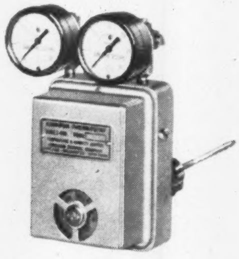
For more information write for bulletin T-800. Johnson Service Company, Milwaukee 1, Wisconsin.



T-800 Capillary Thermostat with 8' Averaging Bulb for Air.



T-802 Rigid Stem Insertion Thermostat for Air.



T-804 Rigid Stem Immersion Thermostat for Liquids.

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